ERIC Document Resume | See Instruction Sheet | DATE OF RESUME | DATE RECEIVED

A. PUBLICATION DATA

1. ERIC NUMBER: ED001919

2. ORIGINATOR CONTROL NO(S).: N.A.

3. IDENTIFICATION NO.: N.A.

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TYPE OF REPORT
PROPOSAL ☐
IN-PROGRESS ☐
FINAL ☒
FOLLOW-UP ☐

OTHER ERIC REFERENCES:

ERIC SATELLITE CODE

4. AUTHOR(S): Board of Education, City of Chicago, Chicago, Illinois

5. TITLE OF DOCUMENT ABSTRACTED: Curriculum Guide for Industrial Arts, Grades 9-12, General Shop, Graphic Arts, Woodworking

6. PUBLICATION TITLE: N.A.

7. EDITOR(S): N.A.

8. PLACE OF ORIGIN
ORG. Board of Education City of Chicago
ST.
CITY, STATE Chicago, Illinois
TELE. EXT.
INST/LOC CODE

9. PUBLISHER OR SOURCE: Board of Education, City of Chicago Chicago, Illinois

10. VOL.	11. PAGES	12. MO./YR.	13. TOTAL PP.
N.A.	N.A.	1963	40

B. INDEXING DATA

14. SUBJECT AREA

15. TYPE OF ENDEAVOR: Curriculum Guide

16. INDEXING TERMS (6-12)

industrial arts	student projects			
shop curriculum	teaching techniques			
secondary schools	graphic arts			

17. ABSTRACT (MAX. 250 WORDS)

Industrial arts, in the curriculum of the modern high school, should teach the principles, techniques, and appreciation of selected trades and crafts as they are encountered in our present industrial society. Some of the goals of the shop manual are to allow the student to evaluate his technical ability, to apply scientific principles to materials, to stimulate inventiveness and to provide knowledge and skill for leisure time expression. Shop safety is the responsibility of the teacher and the student.

General shop activities using electricity, metal, wood, plastics, graphic arts, and leather are outlined with suggested learning experiences. Two or more units can be taught by one teacher, depending on the equipment, teacher training, and student interest. It is recommended not to attempt more than four units because of the wide variety of equipment needed for adequate depth.

Instruction in graphic arts is enriched with demonstrations, class discussions, research assignments, and visual aids. Graphic art is treated fully in two course outlines for two years. Four different course outlines for Woodworking I-IV are provided with suggested projects.

ERIC No.

18. SOURCE OF ABSTRACT

C. FUNDING DATA

19. SUPPORTING ORGANIZATION

20. DIVISION OR DEPT.

21. CONTRACT NO.

PROJECT NO.

22. TOTAL COST OF PROJECT

23. DURATION OR PROJECT

U.S. Department of Health, Education, and Welfare
Office of Education

1

ERIC Form 1

375D.841Ts

Lab

ED001919

CURRICULUM GUIDE for INDUSTRIAL ARTS

GRADES 9-12

ED001919

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GENERAL SHOP
GRAPHIC ARTS
WOODWORKING

BOARD OF EDUCATION
CITY OF CHICAGO

CURRICULUM GUIDE FOR INDUSTRIAL ARTS

Grades Nine through Twelve

Volume One

GENERAL SHOP

GRAPHIC ARTS

WOODWORKING

BENJAMIN C. WILLIS

General Superintendent of Schools

BOARD OF EDUCATION

CITY OF CHICAGO

Educational Materials Laboratory
Office of Education
MAY 1965
DEPARTMENT OF
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FOREWORD

The Curriculum Guide for Industrial Arts, Grades Nine through Twelve, has been developed in three volumes to give the high school shop and drafting teachers an instructional guide which helps to interpret our modern technological society. The course outlines for each of the three instructional areas included in this volume have been developed by teachers and supervisors with frequent validations against the processes of modern industry.

This teaching guide for industrial arts in general shop, graphic arts, and woodworking, grades nine through twelve, contains rather broad and complete course outlines. The content of the teaching guide was evaluated in group meetings by instructional areas, and teacher consultants evaluated the suitability of the instructional content for each of the three industrial arts areas.

Chicago is a widely diversified industrial city, and the high school students vary greatly in their need for industrial arts instruction. The course outlines in industrial arts contain many carefully considered suggestions but should be adapted by the industrial arts teachers to best meet the educational needs of the students in their classes. The three industrial arts areas included in this teaching guide are adaptable to a variety of space and equipment situations and can make a valuable educational contribution to students in the ninth through twelfth grades. The local teacher, principal, and district superintendent are best informed about local educational needs and will know best how to adjust to them.

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Sincere appreciation is expressed to Dr. Philip Buehl of Stout State College, Dr. John L. Feirer of Western Michigan University, Professor Ivan L. Hill of Illinois Institute of Technology, Dr. W. A. Klehm of Eastern Illinois State University, and M. Lloyd Whydotski of Stout State College, who served as consultants to the Department of Vocational and Practical Arts Education in the production of this guide.

Cover design by Homer Freese

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SCOPE OF INDUSTRIAL ARTS

Industrial arts helps prepare students for effective living and intelligent citizenship in our industrial society by providing educational shop experiences which deal with the materials, processes, products, occupations, and problems of our industrial world.

Industrial arts, in the curriculum of the modern high school, teaches the principles, techniques, and appreciations of selected trades and crafts as they are encountered in our present industrial society. In order to provide the students with a sound experiential background upon which to base interpretation of the general principles and broader theoretical aspects of the subject matter, the instructional method in industrial arts is primarily manipulative. These manual activities, involving the tools, processes, and materials of industry, are carried out in specially equipped shops or laboratories in accordance with the area involved. The emphasis in the total program may be technical or vocational. For the student who is college bound, anticipating a career in engineering, more attention is accorded to technical and theoretical aspects. Where high school is terminal education more concern is given to practical aspects and saleable skills. The industrial arts program, administered according to purpose, provides for a range of abilities, needs and goals.

In addition there is a broad aspect of industrial arts, possessing unique educational ramifications, which is frequently overlooked. Industrial arts is a part of our entire technology. While the concept of technology is often used to designate our present industrial society it is actually older than the Greek words from which its nomenclature is derived. Technology includes the entire material progress of our civilization from the first stone used as a hammer by primitive man to the complex rockets which have put man into space.

Technology, man's ingenious use of the earth's resources to subdue his environment, is the inclusive enterprise which engendered the contributing sciences. Man gouged out the first log and proceeded from this beginning to build ships and even navies long before Archimedes defined the principle of buoyancy. To guide his shops on uncharted waters man looked to the stars and called this knowledge astronomy. Discovery of the wheel rendered the need and the empirical basis for mathematical concepts; radius, diameter, and circumference. As simple mechanical devices became more complex the science of physics was born to explain and predict mechanical phenomena. Chemistry evolved to organize and extend man's knowledge of the materials used in his creative progress toward civilization. Technology, man's industry and art, gave grist to the mills of the sciences.

As man's conquest of his environment progressed through millennia of trial, vision, and ingenuity, other things were happening. Languages evolved and communication skills were developed. The need for mutual protection had fostered the beginnings of society. Families merged into clans. Clans grew to tribes. Tribes formed nations. Barter, the seed of economies, came into being as man found himself producer of some things and consumer of others. The world grew smaller as modes of transportation were developed. Trade increased. Tribes and nations went to war to gain commercial advantage. Each advance of technology solved some problem and produced others. And as problems arose there came to be elders, prophets, and philosophers to ponder upon them. As technology gave rise to related disciplines it permitted of others, and man found time to pursue art, music, and literature.

The vast panorama of techology is difficult to comprehend. The sphere of the individual is so minute in comparison. With the increasing interdependence of individuals and societies in the modern world it is incumbent upon the schools to relate each subject to the overall evolution of our heritage. To know the limited knowledge of the past and simultaneously to experience the wonders of the present enables one to feel the change, appreciate the progress, envision the future, and anticipate new challenges. Industrial arts, in the curriculum of the modern school provides real and vivid glimpses of the singular accomplishments of mankind. It gives footings of depth to the breadth of the total curriculum.

All knowledge required by an individual cannot be acquired through firsthand experience. Therefore it is the method of education to train the student to learn by increasingly abstract presentations. As the scope of abstract presentations broadens there accrues a need for episodes of real experience upon which to base this expanding knowledge.

The boy who has fashioned a foot stool from wood has experienced a portion of the technology of man. In the course of his efforts he has blundered and succeeded, even as an earlier man felt failure and success. He has used hand tools, and by this actuality spans the progress of thousands of years when he crosses the room to use a power saw. Each student, primitive in that he has experienced so little of life, encounters some of the struggles, the experimentation, and the ideas that comprise the total progress.

In the metal shop he hammers, rivets, solders, welds, saws, and chisels, using processes which took ages to evolve. He encounters problems of design and reluctance of materials to know the frustrations and elations of an earlier man. His experiences range from the handwork of the forge to the precision of the machine shop. Though working with plastics which he formed into fantatic shapes, he realizes and appreciates the wonders of synthetic materials.

The industrial arts program provides a kalediOscope of the experiences in the total technological progress. Through this compendium the student of industrial arts has a firmer basis for understanding what he reads in history, geography, and the other social sciences. For him the meaning and purposes of the exact sciences have greater depth. In addition, the whole program renders a long view which provides a philosophical basis for the evaluation of our present society as it prepares for the future. Meanwhile our imaginations are piqued. Perhaps, at this moment, on a distant planet somewhere in the galaxies of the universe a man is picking up a stone to begin a civilization.

The major goals of industrial arts in grades nine through twelve are:

1. To provide experiences with hand tools and machines so that the student may evaluate his technical ability and desire for further study in a specific area.

   A student should have an opportunity to work with the materials, tools, and machines that are representative of the community so that they may experience what adults do to earn their living. He should have access to several areas of work and materials so he may accurately weigh his choice of likes and dislikes for each field of employment offered. This should direct him at an earlier date into further study along the field of endeavor to which he feels he is most suited.

2. To develop correct technical skills commensurate with the grade level of the student as evaluated by criteria of competent craftsmen.

   Accuracy and perfection of finish is desired in completed projects. However, it is realized that often there is not the same degree of muscular coordination at age 14 or 15 that might be found at age 17 or 18. It should also be realized that inferior work, due to lack of interest or effort should not be accepted, regardless of age. Representative projects in each area should be on display, so the beginning worker may evaluate his own accomplishments.

3. To apply correct scientific principles from the physical sciences to the project being undertaken in the shop laboratory.

   Sound basic engineering principles should be applied to all projects that are made in the industrial arts shops. Miter joints that meet at corners need to be cut to the proper angles, and shelves of a book rack need to be fastened to the ends so as to form a right angle to hold books properly. Strengths of materials should be considered in relation to the design of the particular project.

4. To stimulate inventiveness in the development of projects by encouraging the use of original design and the use of modern materials.

   New products are being invented or produced daily and this application of invention and improvement should be encouraged in all laboratories where students work. Individual creative thinking, an earmark of the ingenuity of the American citizen, should be encouraged. Modern synthetic materials such as hardboard, chipboard, new cements and bonding materials, and solid and fluid plastics should be available in the shop so the student will have firsthand experience with materials which industry has developed for today's craftsmen.

5. To develop the student's social appreciation through his cooperation as a member of a group on a worthwhile project to be utilized by the school or community.

   Occasionally it is desirable to secure the skills and time of the student to assist in designing and constructing a project such as scenery frames for a school stage, equipment for a Boy Scout summer camp, or a scoreboard for an athletic field. Contributing to such projects develops a sense of social appreciation.

6. To evaluate good work habits through participation in projects executed with diligent care and exactness.

   Activity patterns can easily be set for life at the high school student's age. Organization of good shop procedures and patterns should at this formative age tend to influence the student's work habits. We, in our evaluation of his completed work, should point out the best parts of his craftsmanship first, followed by showing where he might improve.

7. To cultivate an appreciation of good design and materials, and technically correct construction in manufactured objects.

   Pointing out the artistic qualities of well-designed industrial projects which are brought into the shop will instill in receptive students an appreciation for good design, balance, and construction.

8. To develop knowledge and skills for leisure time expression to help fill the ever increasing shortened work week.

   Knowledge gained in industrial arts classes better prepares people to develop worthwhile creative hobbies.

9. To teach safety and health precautions when using materials, tools, and machines in the school, in the home, and in industry.

   Public health and safety should be stressed at all times. In industrial arts there is an excellent opportunity to project this phase of a student's training so that he is constantly aware of its importance to society.

10. To improve home environments and oonditions through the knowledge and skills learned in the major fields of the industrial arts.

    Repairs or alterations are required in homes from time to time, or on the manufactured items found in the home. Persons who have had basic industrial arts training in school should be better qualified to do the work, or to intelligently employ a competent craftsman if outside help is necessary.

11. To introduce to the student through direct learning activities the major types of occupations which adults follow in industry.

    Industrial arts presents to the student the various kinds of work pursued by tradesmen in their given areas. When a student works with the materials and tools of the electrical, metal, or woodworking trades, he should have a better idea of what the adults do in making their living following those trades.

12. To endeavor to develop wholesome personality balance by promoting good classroom climate.

    An alert instructor will organize and conduct his class so that the participating student will develop qualities of good citizenship.

SHOP SAFETY

Reasons for safety in the shop, or anywhere for that matter, are obvious. Basically, safety is a matter of survival. The responsibility of the school to give instruction in safety and to attend to thw well-being of the students unders its care is clear from both humanitarian and utilitarian points of view. In addition there is the aspect of legal responsibility of school boards, school principals, and individual teachers. Thus careful attention to the maintenance of a hazard-free shop is a necessity.

Smooth-running saws can inflict a serious cut almost before the operator is aware of being injured. Wood lathes can throw off, with great force, a defective or improperly mounted piece of face plate work. Loose neckties and sleeves, caught in moving machine parts, can pull a careless person to probable injury. Many aspects of the shop program, molten metals, high temperature flames, electric arcs, shapr hand tools, present dangers to the student who is careless or uninformed. If these hazards are fully realized and meticulously aovided, the many advances in technology and in the use of modern machinery can be efficiently exploited.

How is a safe shop achieved? In a situation where a single mistake is final and irrevocable, what means can be employed to indoctrinate the students with a never-failing concern for safety? As it is with most endeavors in the educational enterprise, the teacher is the focal point. A constant awareness on his part, shown through continuing example and instruction, is likely to produce in his students a similar regard for cautious procedures. It is only through his efforts that optimum conditions within the laboratory can be realized.

Setting up and operating a safe shop involves several factors. Some are specific and pertain to physical conditions; others are general and relate to matters of attitude, the working climate, and phases of organization which make the shop a precisely functioning enterprise. All are important, and the conscientious instructor will neglect no opportunity to improve the conditions under which he and his students work.

PHYSICAL AND ENVIRONMENTAL FACTORS

The initial planning and layout of a shop encompasses the consideration of safety factors. It frequently happens, however, that when additional equipment is acquired or new work stations are established, these considerations are overlooked. The teacher should regularly check his shop to be certain that physical conditions are optimum for neatness, efficiency, and safety. It would be a good practice to prepare a checklist for the specific shop which would include pertinent applications of the following factors:

1. All machines must be kept in perfect operating condition, with guards and safety devices in place. Each machine should be established as a definite work station with lines painted on the floor to indicate the area within which only the operator is permitted. As an added caution to the student, red paint can be used to indicate dangerous moving parts. Specific safety rules for each machine should be mounted in a conspicuous spot on or near the machine.

2. Power control (switches, types, and location) must be evaluated. Ideally, there should be a master switch with a lock, so that all power in the shop can be turned off. Each machine should have its individual switch and some machines should be equipped with locks. Most of the heavier equipment in school shops is installed with appropriate controls. Hazardous conditions can occur when smaller pieces of machinery are added and where makeshift extension cords, with pull chains and push buttons, are used to control the power supply. The switch should always be a permanent installation, firmly fastened to the machine or mounted on an adjacent bench surface, and located so that the operator can control it without moving from his working position.

3. Adequate lighting is important. If natural light or the regular room lighting is insufficient, individual lights must be provided.

4. Work stations should be located and maintained in such a way as to provide the proper conditions for the specific activity involved. For example, the finishing area should be separate from any station where open flame might be used. At each station only the equipment and materials needed for the job should be on hand.

5. Where volatile materials are being used adequate ventilation must be provided. Provision should be made for the disposal of oily rags and for the proper storage of paints, lacquers, and solvents. Even where proper metal waste containers are used, they must be emptied frequently to prevent spontaneous combustion.

6. At a station where open flame is used or where soldering is done, adequate fireproof covering must be provided for the bench top, and shields should be erected where needed. An approved fire extinguisher should be prominently and strategically located.

7. All work stations and machines should be located in accordance with the amount of teacher-supervision they individually require.

8. Hand tools must be properly sharpened and otherwise readied to do effective work and to minimize the chance of accidents. Retire any tool that is defective and cannot be repaired. Something as simple as a loose hammer head or a file without a handle can cause serious injury.

9. Good housekeeping (clean floors, uncluttered bench tops, neat storage, removal of dust accumulations) is another factor in the maintenance of a safe shop. A general maxim of "keeping the decks cleared" for the task at hand not only promote safety but also increases efficiency.

ORGANIZATIONAL RESPONSIBILITIES OF THE TEACHER

Well-established shop routine is necessary if accidents are to be prevented. Following an orderly procedure has the added effect of inducing a businesslike atmosphere which promotes learning as well as safety.

1. There should be a standard operating procedure for all routine shop activities. Removal of ties, rings, and the correct rolling or buttoning of sleeves, should be done by all students at the beginning of the shop period. Tool and material procurement should be systematized.

2. To prevent crowding of students around any one location, with the attendant discipline problems and safety hazards, it is necessary to ascertain the number of work stations and to make assignments accordingly. The ideal situation is to have as many work stations as there are students. However, where conditions require, various systems of rotation can be devised.

3. There should be a definite system whereby the student obtains permission to use power machinery. This can include regular checking of setups by the instructor before the student is allowed to proceed. During this process, the student can be indoctrinated, by the example of the teacher, to turn the machine over by hand before turning on the power.

4. The shop must always be supervised. If the teacher must leave the room, all power should be turned off and the administrative office notified so that supervision can be provided.

INSTRUCTIONAL REPONSIBILITIES OF THE TEACHER

The best safety instruction is done daily in relation to specific machines and procedures. The practice of devoting one of the early class sessions entirely to safety is ineffective and insufficient. Either the treatment is too general to result in useful understand or, if specific, too detailed to be effectively rememberd. Use of the following techniques will make safety instruction an integral part of the instructional program:

1. Job sheets should contain the exact safety rules and precautions which pertain to the machines and processes involved.

2. Every demonstration by the teacher must contain explicit precautions related to the procedure. He can anticipate, or recall from past experiences, some of the mistakes that students might make and point them out.

3. The teacher should provide instruction in the making of various improvised safety devices, such as pusher sticks, hold-downs, and jigs for drilling.

4. All means, such as oral questioning during and after demonstrations and regular testing of safety instruction in formal tests and quizzes, must be used to insure student attention and understanding.

STUDENT RESPONSIBILITY

The development of a sense of responsibility in students has always been a primary goal of education. If the teacher's efforts in promoting safety are to be effective, it is imperative that the student know his obligations and comply with the rules pertaining thereto. Twelve general safety rules for students are printed on the back of the regular permission slip (Hi. 150) which is available from the Division of Supplies. These rules are comprehensive and compliance with all of them by all students would reduce accident risks to an absolute minimum. To insure that the students have been made aware of their safety responsibilities and to impress upon them the need for their cooperation, the teacher should do the following three things:

1. Give each student a copy of the rules for his notebook. Read and discuss each rule during one of the initial shop periods.

2. Post a copy of the rules on the bulletin board. For each class, add a suplementary sheet headed with the following statement to which each boy in the class subscribes:

   > I have a copy of the above rules in my notebook and have received instruction in their meaning and in the importance of my obeying them.

3. Take formal notice of any safety rule infraction. The first warning might be verbal but a second offense ought to become a matter of record.

A safe shop and an effective program of safety instruction require advance organization and constant daily emphasis. Even though all possible precautions are taken, it must be realized that an accident still might occur. To cover legal inquiry adequately, it is essential that concrete evidence be available. Times, dates, witnesses, action taken, and other pertinent data should be matters of accurate record. The teacher should consider that he might be asked by the principal, or an insurance investigator, for a description of how an accident occurred. Would any of the circumstances be such that the accident could have been prevented? Is the condition of the shop such that it would bear objective scrutiny? Would the teacher have accurate records which would establish him as a thorough, prudent individual who had the welfare of his students foremost in his mind? In general, could he show that he had taken all reasonable precautions to prevent this kind of accident? Following are things which every shop teacher can and should do to protect the student, the principal, the school board, and himself:

1. Permission slips to operate power driven machinery must be on file for every student. The signing of a permission slip by the parent does not release the school from liability in the event of negligence. However, it does show that the parent is aware that his boy is using such equipment. Further, its uses provides concrete evidence of attention to safety, is an effective component of the instructional program as it relates to safety, and serves to apprise both student and parent of the seriousness of the matter.

2. Keep a record of all first aid administered. Include date, time, name of student, kind of injury, part of body, nature of first aid, and other pertinent information. This enables the teacher to answer future questions accurately should such arise.

3. Submit accident reports promptly on the regular form (Safety 100) for any accident sufficiently serious to warrant it. When in doubt, the instructor should check with the shop superintendent or the principal.

4. A record of infractions of shop rules should be maintained for each student with provision for guidance and counseling. This will impress upon the students the need for obeying rules and will keep matters of safety in constant, purposeful focus.

Maximum control is a major factor in the prevention of accidents. It also spells success in the instructional program. The achievement of a safe, precisely organized shop is a tribute to the teacher and pays high dividends in learning and safety.

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Graman, Herman R. A Good Mechanic Seldom Gets Hurt. Chicago: American Technical Society, 1945.

Silvius, G. Harold, and Baysinger, Gerald B. Safe Work Practice in Sheet Metal Work. Chicago: American Technical Society, 1948.

Silvius, George Harold, et.al. Safe Practices in Woodworking and Plastics. Chicago: American Technical Society, 1954.

Shop teachers should have all three of these books. It is not necessary to have one for each student. The application of the material in these books to a specific shop situation would enable a teacher to formulate rules for all machines and work stations and ascertain precautions to include in his demonstrations and job sheets.

FILMS

Safe Use of Tools. Coronet Films, 1941. 6 min. b&w (X-T-17).

Safety With Everyday Tools. Coronet Films, 1952. 10 min. b&w (X-S-34).

Industrial Arts: A Safe Shop. Young America Films, Inc., 1955. 11 min. b&w (X_I-55).

GENERAL SHOP INTRODUCTION

The following areas of instruction are well adapted for the general shop: electricity, metal, wood, plastics, graphic arts, and leather.

Two or more of these units are taught by one teacher in one shop, the number of units depending on the shop equipment, the teacher's training, and student interest. It is generally recommended that not more than four units be used because of the wide variety of equipment needed for adequate depth.

Shops should be laid out and equipped to provide adequate instructional depth and provide a challenge to the various levels of student interest and ability. The general shop is well suited to the small school with one or two teachers, or as the first shop course in larger schools.

UNIT I: ELECTRICITY

UNDERSTANDINGS

The student should:

- develop background knowledge of the early history and developments in electricity
- understand the basic laws of electricity and the terminology and symbols used in electrical work
- understand the various sources of electrical energy

OUTLINE OF CONTENT

A. Early history and discoveries in electricity
   1. Scientists of the period
   2. Nature of discoveries

B. Fundamental laws of electricity
   1. Terms of measurement
      a. Volts
      b. Amperes
      c. Watts
      d. Ohms
   2. Ohm's Law

C. Electrical symbols
   1. Basic industrial symbols
   2. Radio and electronic symbols
   3. Use of symbols in schematic drawings

D. Static electricity
   1. Behavior
   2. Generating
   3. Lightning
   4. Control and use

E. Magnetism and type of magnets
   1. Natural

SUGGESTED LEARNING EXPERIENCES

Discuss the work of early scientists and, especially that of physicists who pioneered research in the electrical field. (References: 1, 8).

Have the students read resource material about such men as Volta, Franklin, Faraday, Maxwell, Marconi, Edison, De Forest, Hertz, Oersted, and others distinguished for their work in the electronics fields. (References: 1, 8).

Introduce the terms of electrical measurement. (References: 1, 8, 12, 13).

Use charts, blackboard illustrations, and notebooks to familiarize students with the systems of electrical symbols used for industrial wiring and also the symbols used for radio and similar electronics schematics. (References: 1, 6, 8, 11, 12, 13).

Provide blueprints, drawings, and schematic diagrams for students to work with in order to gain some proficiency in the use and reading of drawings and schematics. (References: 6, 12, 13).

Discuss sources of static electricity and use demonstration apparatus to create static charges; show how the presence of static charges affect the electroscope, pith balls, inflated toy balloons, and similar static apparatus. (References: 1, 9, 11).

Explain the attraction of dissimilar charges and the repulsion of like charges. Demonstrate. (References: 1, 9, 11, 13).

Place experimental apparatus at the disposal of students to observe the action of static electricity. (References: 1, 9, 11).

Explain and demonstrate that electricity may be produced by light as in photoelectric cells. (References: 11).

Explain and demonstrate the piezoelectric effect, the production of electric current by pressure. (References: 11).

Demonstrate the various properties of natural magnets and the basic laws of polarity. (References: 1, 9, 11).

Illustrate by chart or blackboard sketch the molecular arrangement in magnetized metals. (References: 1, 4, 9, 11, 13).

understand the chemical actions which take place in the voltaic cell and the dry cell to produce chemical electricity

understand the construction of the storage battery and the chemical action which takes place during charge and discharge

understand how coils are used in motors, generators, transformers, and other electrical apparatus

2. Permanent
3. Electro

F. Chemical electricity

    1. The voltaic cell

        a. Construction
        b. Uses

    2. The dry cell

        a. Construction
        b. Uses

    3. The storage battery

        a. Construction
        b. Types
        c. Charge and discharge
        d. Uses

G. Generating of electricity mechanically (A.C.)

    1. The magnetic field

        a. Permanent magnets
        b. Electromagnets

Use a lodestone to demonstrate its magnetic properties and show how it may be used to "charge" a piece of unmagnetized steel. Demonstrate compass effects of magnetized steel. Have students make magnetic field patterns using iron filings. Use a dry cell, wire, card and iron filings to show the magnetic field around a wire in which a current is flowing. Wind several electromagnets around soft iron, steel, and magnetic steel cones to demonstrate the effectiveness of the electromagnet. Make iron filings tracings of the electromagnetic field. Wind a hollow core coil (solenoid) and demonstrate its use for magnetizing steel. Provide a magnetizing coil project for student construction. (References: 1, 2, 4, 6, 8, 9, 10, 11).

Demonstrate the action of the voltaic cell, using carbon and zinc rods in a solution of salammoniac. Test the cell for e.m.f. with a galvanometer. (References: 1, 6, 9, 11).

Demonstrate the primary cell, using two dissimilar metals, such as copper and zinc immersed in a 10% sulfuric acid solution or in fresh lemon juice.

Test with the galvanometer. (References: 1, 9, 11).

Explain the process of ionization in the primary cells and the manner in which polarization decreases voltage flow through internal resistance. (References: 8, 9, 11).

Present a cutaway dry cell to the class and explain its contents and the functions of its components. (References: 1, 4, 6, 8, 9, 11).

Demonstrate use of ammeter to test condition of cell. (References: 11, 13).

Make a simple galvanometer as a project, using a compass mounted in a coil of magnet wire. (References: 13).

Construct a simple storage cell, using lead plates immersed in a sulfuric acid electrotype. Charge and discharge cell to demonstrate change in plate composition. Explain the charge-discharge process in the lead acid storage battery. Display a cutaway view or model of a lead acid storage cell. (References: 1, 4, 6, 8, 9, 11).

Review permanent magnets and electromagnets and the magnetic field. (References: 11, 13).

Using a coil of wire, a permanent magnet, and the galvanometer, demonstrate how a current flows when a coil of wire cuts the lines of force in the magnetic field - induced current. (References: 1, 4, 6, 8, 9, 11, 13).

develop understandings of current flow, electrical circuits, and methods of protecting electrical circuits

understand the basic differences between alternating and direct current and methods of power transmission to consumers

gain some understanding and ability in the use of the more commonly used instruments for electrical measurement and metering

comprehend the importance of electricity in communication

develop worthwhile leisure activities in electronic pursuits appropriate to his ability and interest

develop an appreciation of good materials, design, and workmanship in electrical goods

gain an understanding of the industrial importance and the employment opportunities in the fields of electronics

achieve reasonable skills in the safe handling and use of electrical equipment

2. Coils
    a. Generators
    b. Motors
    c. Transformers

H. Current flow
    1. Electron theory
    2. Rule of thumb
    3. Conductors
    4. Insulators
    5. Resistance

I. Circuits
    1. Series
    2. Parallel
    3. Series parallel
    4. Short circuits

J. Circuit protection
    1. Fuses
    2. Circuit breakers
    3. Safety devices

Show by charts, diagrams, and demonstration how the above principles are applied to generation of A.C. current. (References: 8, 9, 11, 13).

Using two coils of wire and iron rod, show how current is induced. Explain how the principle of induction is employed and regulated in step-up and step-down transformers. (References: 6, 8, 9, 11, 12, 13).

Have students construct a simple electric motor with permanent magnet for field energy. Design and construct small electric motors with electromagnetic field coils and wound armatures or electric motors operating on the solenoid principle. Have students construct a small step-down transformer. (References: 1, 3, 4, 6, 8, 9, 11, 13).

Use charts, models, and graphs to illustrate and explain the electron theory. Have students construct models of atomic solar systems using wire and ping-pong balls or similar devices to illustrate atomic structure. (References: 1, 4, 9, 10, 11, 13).

Explain the changes in "balance" that cause electrons to move from one atom to another, resulting in electrical flow. Explain and demonstrate the "left-hand" rule of electron flow and polarity. (References: 1, 4, 9, 11, 13).

Provide samples of conductors and insulators, and demonstrate the efficiency of conductors, pointing out the property of resistance in some materials. (References: 1, 4, 6, 8, 11, 13).

Demonstrate the heat and light effects of resistance to current flow. Have students construct a continuity tester. Have students test various materials for resistance and learn to use Ohm's Law. (References: 1, 3, 4, 8, 9, 11, 13).

Construct projects using field or variable resistances for controlling small motors, lights, etc. Have students construct projects employing resistance wire and producing heat, such as a simple toaster, coffee warmer, "hot dog" roaster. (References: 1, 3, 6, 8, 11).

Demonstrate low voltage and high voltage effects in series and parallel circuits. (References: 1, 8, 9, 11, 12, 13).

Provide bells, buzzers, batteries or transformers, wire sockets and bulbs, so that students can wire and operate a variety of low voltage circuits. Observe effects of short circuits and stress safety in handling electrical apparatus of any kind. Demonstrate and illustrate the various methods of circuit protection used in homes and industrial installation. Stress safety in handling and testing high voltage circuits. (References: 1, 2, 4, 5, 11, 12).

Provide materials and tools so that students may make approved electrical taps, splices, and electrical connections. Demonstrate acquire good safety habits in the use and handling of tools and electrical devices in the shop and in the home

develop skills in the use of the basic hand tools used in the electrical industry

develop reasonable skills in wiring simple circuits and in using the soldering tools

gain understandings of the principles of radio communication and the basic circuits used to transmit and receive messages.

K. Power transmission
    1. Generating plants
    2. Transformers
    3. Transmission lines
L. Direct current
    1. Industrial uses
    2. Mobile uses
M. Alternating current
    1. Industrial uses
    2. Home uses
    3. Communication uses
N. Measuring of electricity
    1. Voltmeter
    2. Ammeter
    3. Ohmmeter
    4. Watt-hour meters
    5. Special meters
O. Communication
    1. Telegraph
    2. Telephone
    3. Radio
    4. Television

use of newest types of solderless connectors used by the electrical industry. Demonstrate correct methods of soldering connections and provide students with facilities for soldering taps and splices. Suggested projects follow: table lamps, extension cords, fluorescent light. (References: 1, 2, 3, 4, 5, 6, 10, 12).

Demonstrate and use visual aids to show how power is generated and distributed to consumers. Have students build models or draw charts of power supply for a small city or a local power plant and distribution system in a large city.* (References: 1, 4, 12).

List some of the principal uses of direct current for industrial and domestic use. Explain or demonstrate the operation of arc welders. Illustrate differences in D.C. and A.C. generators. Discuss automotive, marine, and aircraft uses of D.C. Illustrate or perform service operations necessary for maintenance of D.C. mobile electrical systems, such as generator, battery, and voltage regulator. (References: 1, 4, 9, 11, 13).

Explain advantages of A.C. current over D.C. for domestic and industrial uses. Build a miniature generator, using alnico magnets for the armature and wound field coils. Discuss and demonstrate service operations and maintenance operations for home electrical appliances. Discuss consumer information regarding home appliances. (References: 1, 4, 8, 9, 11, 12, 13).

Make necessary equipment available so that students can operate voltmeter, ammeter, and ohmmeter. Demonstrate the correct and safe use of these measuring devices. Have students test circuits with the meters and apply Ohm's Law. Have students learn to read the watt-hour meter. (References: 1, 4, 8, 9, 11, 12, 13).

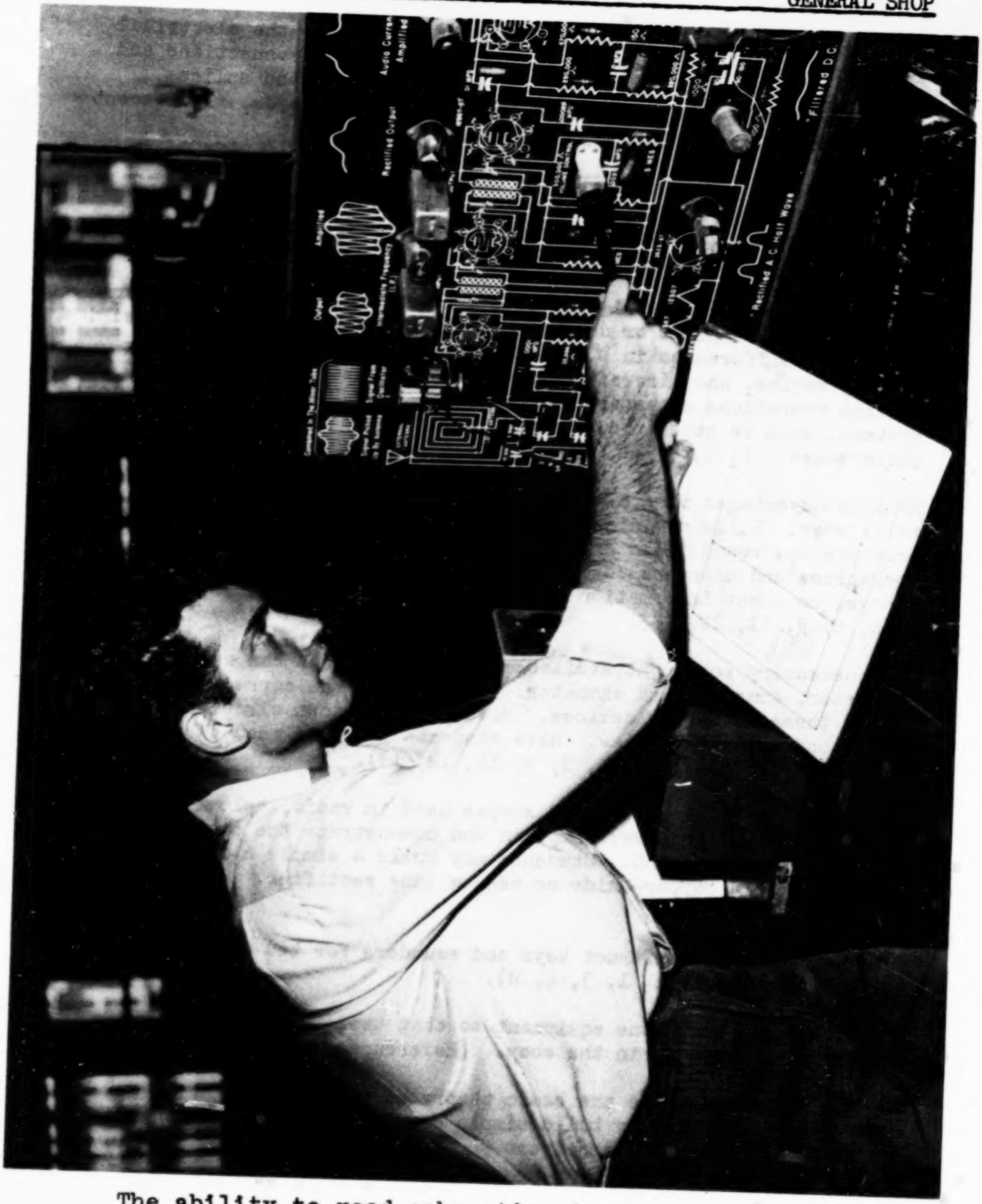
Demonstrate special meters and scopes used in radio, television, and other communication work. Explain and demonstrate the process of rectifying A.C. current. Students may build a simple 6-12 battery charger using a copper-oxide or vacuum tube rectifier.* (References: 9, 10, 13).

Have the students construct keys and sounders for two-way telegraph system. (References: 1, 3, 4, 8).

Make available telephone equipment so that two, three or four phone systems may be set up in the shop. (References: 1, 3, 4).

Explain and demonstrate the basic theory of radio transmission and reception. Students may build simple crystal reciver, may construct one, two, or three tube receivers.* (References: 1, 3, 4, 6, 8, 9, 10, 13).

*For the more able student


Audio Current Amplified
Rectified Output
Amplified
Output
Intermediate Frequency (I.F.)
Super Freq. Oscillator
Combined In The Mixer Tube
Signal Picked Up By Antenna
Rectified A.C. Half Wave
Filtered D.C.

The ability to read schematic circuit drawings is essential to understanding the functions of radio and television components.

ELECTRICITY

Demonstrate the use of transistors in place of vacuum tubes. Construct pocket transistor radio receiver.* Construct radio or telegraph code practice set. (References: 10, 13).

Demonstrate the trouble shooting techniques used in tracing difficulties in radio circuits. Discuss vocational and employment possibilities in the radio-television industry. (References: 1, 10, 13).

Explain by chart and demonstration the basic principles of telecasting. (References: 4, 6, 8, 13).

Demonstrate V.T.V.M., V.O.M., and scopes and uses in T.C. trouble-shooting. (References: 10, 13).

Construct hi-fi systems for home use.* (References: 10, 13).

*For more able student

DEVELOPMENTAL VOCABULARY

ampere
atom
amalgamate
current
dielectric
electroscope
electrolyte
electron
electrostatic
E.M.F.
galvanometer
hydrometer
ionize
induction
kilowatt
local action
magnetic
ohm
polarization
potential
primary cell
rectification
resistance
secondary cell
specific gravity
static
volt
watt

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FILMS

The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools, Chicago Board of Education, 1961.

Development of Communication. (Revised) Encyclopaedia Britannica Films, Inc., 1955. 11 min. b&w (X-C-36).

Mr. Bell. Illinois Bell Telephone Co. 30 min. b&w (X-B-39).

Western Crossing - Laying Telephone Cable. American Telephone & Telegraph, 1943. 11 min. color (X-C-19).

Electricity. Gateway, 1951. 8 min. b&w (X-E-50).

Flow of Electricity. Young America Films, Inc., 1946. 10 min. b&w (X-E-27).

Learning About Electric Current. Encyclopaedia Britannica Films, Inc., 1955. 8 min. b&w (X-L-79).

Making Electricity. Encyclopaedia Britannica Films, Inc., 1949. 10 min. b&w (X-M-124).

ELECTRICITY

What Is Electricity? British Electric Development Association, 1953. 13 min. b&w (X-W-77).

Magnetism. Encyclopaedia Britannica Films, 1953. 15 min. b&w (X-M-161).

Magnets. Young America Films, 1946. 13 min. b&w (X-M-88).

Magnets. Young America Films, 1946. 13 min. b&w (X-M-152).

Water Power. Encyclopaedia Britannica Films, 1937. 11 min. b&w (X-W-4).

Copper Network. U. S. Bureau of Mines - Phelps Dodge Copper Products Inc., 1957. 23 min. color (X-C-136).

FIELD TRIPS

Students working in the electrical area frequently profit from field trips. These should always be prearranged by phone or letter. Bus transportation arrangements may be made by calling:

Illinois Bell Telephone Company
Call: OFficial 3-9100

Museum of Science and Industry
Call: MUseum 4-1414

Chicago Lighting Institute
Call: ANdover 3-5194

Commonwealth Edison Company
Write for arrangements to:
Public Relations Department
Commonwealth Edison Company
72 West Adams Street
Chicago 90, Illinois

OTHER SUGGESTED FIELD TRIPS

Radio Broadcasting Station
Television Studio
Municipal Airport Tower
Weather Bureau Radar Station.

UNIT II: GRAPHIC ARTS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Early history of man's efforts to produce a graphic record
develop an understanding of the importance to man of devising practical methods of recording his progress	1. Pictorial stories of the primitives
learn about a man's early attempts to draw and preserve pictorial stories of his achievements and to leave a record of his history	a. Cave pictures b. Pictures in clay c. Written messages in clay 2. Early writing and use of symbols
develop understanding of man's development of an alphabet and combinations of characters which would permit him to put down his story in words	a. Use of skins and parchments b. Development of papyrus by Chinese and Egyptians c. Inks and dyes 3. Written records of the middle ages
know about the early methods of making paper, parchment, and inks	a. Use of skins and papyrus b. Books and scrolls of the monks
understand the early method of writing and copying books by the monks and scholars	4. First attempts at printing
develop a knowledge of the books of Lourens Koster and his work with wood block pictures and plates	a. Lourens Koster and his wood block pictures and plates b. Gutenberg's Bible, development of movable metal type c. Operation of early presses such as Gutenberg press

SUGGESTED LEARNING EXPERIENCES

Help students develop an understanding and appreciation of man's laborious efforts throughout history to record the story of his life.

Organize a field trip to the Chicago Museum of Natural History where examples of man's early attempts to write may be seen first-hand in the exhibits and dioramas of Cro-Magnon man, Egyptian heiroglyphics, and the tablet writings from Ancient Rome and Greece. (References: See Field Trips).

Encourage students to visit the main branch of the Chicago Public Library and the Crerar Library where examples of man's first hand-scribed and hand-illustrated books may be seen. (References: See Field Trips).

Encourage students to use reference books which illustrate the various tools and materials man used for writing from stone and clay tablets to his development of parchments, quills, and ink. (References: 9).

Describe for students the early methods of printing with letters and pictures carved in wood to produce the block books such as those printed by Lourens Koster in Antwerp circa 1417. (References: 9, 12).

Discuss with students the great importance of Gutenberg's invention of movable type circa 1438. (References: 6, 9, 12).

develop an understanding of Gutenberg's work in developing movable type and the mode of operation of his printing press

have an understanding of the wide variety of jobs and vocational opportunities existing in the graphic arts and related industries

understand the importance of the graphic arts and know the location of the country's principal printing and publishing areas and the prestige of Chicago as a printing center

understand the process involved in making type, such as the alloys used, and the automatic casting machinery and the principles used in the linotype and monotype machines

recognize the common styles and faces of type

understand the point system of measurement used in designating type size and the importance of type size in planning the layout of the printing job

understand how lead slugs, rules, and leaders are used, and how space and quads are utilized in setting up a job

B. Employment opportunities in graphic arts

  1. Types of employment

    a. In the job shop
    b. Newspaper and magazine publishers
    c. Commercial printers
    d. Lithography - Offset

  2. Related industries

    a. Papers and inks
    b. Type foundries
    c. Machinery and equipment
    d. Advertising

C. Printers' Type

  1. Alloys used for type

  2. Foundry type

  3. Automatic type casting machines

    a. Operating principles of linotype and intertype machines
    b. Operation of monotype machines

  4. Type sizes and faces

    a. Point system of measuring type sizes
    b. Common type styles and faces used in printing
    c. Uses of lead slugs, rules, and leaders
    d. Use of the spaces and quads

Lead a class discussion covering the great number of employment opportunities existing in the graphic arts and related industries. (References: 3, 4, 6, 12).

Exhibit a number of pieces of type, such as foundry type, linotype, and monotype and permit pupils to handle and examine them.

Explain the process of casting type in the foundry and the casting process as done by machines, such as linotype and monotype. (References: 3, 6, 7, 8, 9, 12).

Discuss the accuracy standards maintained in the manufacture of type and explain to students how lead alloys are mixed to retain accuracy in casting. (References: 3, 6, 7, 8, 9, 12).

Present graphic examples of the wide variety of type faces available for printing and explain to pupils how these present day type styles are the evolutionary result of the original type faces designed by the early European type makers. (References: 3, 6, 7, 8, 9, 12).

Explain the terminology used to describe the parts of a type, by giving each student a large piece of type and using a wall chart or large model of a type to illustrate. (References: 1, 3, 6, 7, 8, 9, 12).

Illustrate type sizes to students through the use of printed sample reference sheets or type size reference sheets in a text or reference book.

Familiarize students with the spacing material used with hand set type.

understand the California Job Case and learn the locations of the upper and lower case characters, as well as the location and size of the spacing material, plus the locations of the ligatures, numbers, symbols, and points

use the line gauge to measure and to identify type in point size and style

develop skill in setting and holding the composing stick

develop skill in placing the club, setting type in the stick, and using spacing material correctly

learn how to justify the lines and how to correct each line for errors

develop dexterity in removing type from the stick to the galley and tying it after each day's work

learn how to read the lines of type from left to right with the nicks in proper position so that characters are upside down

learn to remove a line galley and replace it in the stick for correction

D. Hand Composition

1. The California Job Case

   a. Upper case characters
   b. Lower case characters
   c. Spacing material
   d. Ligatures, numbers, symbols and points

2. Setting of type

   a. Use of the line gauge
   b. The composing stick
   c. Preparing the layout
   d. Setting the stick and placing the lead or slug
   e. Setting the type in the stick
   f. Use of spaces and quads
   g. Checking each line for errors
   h. Justifying the lines

Explain the layout of the California Job Case. (References: 3, 6, 7, 8, 9, 12).

Prepare students for setting type by providing each with a California Job Case and a chart so that they may become reasonably familiar with the locations of the letters in upper and lower case and the location of ligatures, numbers, points, and spacing material.

Demonstrate to students what the printer means by "Demon Characters" and exhibit proofs of the letters d, b, p, g, n, u, 9, 1, i, l, capital o, small o, zero, comma, and apostrophe. (References: 1, 6, 8, 9).

Illustrate how errors in setting type occur if the student is careless in distributing the "Demon Characters."

Direct students in the procedure of setting type by providing each with a font of type, composing stick, and a short paragraph of copy.

Show students how to use the line gauge and how to hold the composing stick. (References: 1, 3, 6, 7, 8, 9, 12).

Demonstrate the correct method of handling type cases and illustrate the results of carelessness in handling cases, sticks, and galleys full of type.

Show students how to set the composing stick correctly, place the slug, and set a line of type.

Demonstrate to students how lines of type are justified and tightened in the stick. (References: 1, 3, 6, 7, 8, 9, 12).

Show students how to remove several lines of type from the stick, place it in the galley, and tie it for proofing. (References: 1, 3, 6, 7, 8, 9, 12).

Demonstrate the inadvisability of setting more than half a tick of type at a time and show students the advantage of correcting each line for errors before removing the material from the stick for proofing.

Display several charts in the shop which show the standard proof marks and teach students to read, mark, and oorrect proof. (References: 1, 3, 6, 7, 8, 9, 12).

learn to prepare the proof press for making a proof, including inking the disk, cleaning the type after pulling a proof, and cleaning the proof press and brayer

maintain high standards of safety with solvents and rags; develop good work habits necessary to maintain a clean, safe shop

understand the proofreader's marks and learn to use them in reading and correcting the proof

develop skills in handling and cleaning type after use and to exercise skill in redistributing type

practice the various type setting jobs normally encountered in the job shop, such as setting single lines, calling cards, stationery, straight composition, handbills, and name lists

understand the platen press, its operation, controls, safety practices, and care of the press after use

3. Making of a proof
   a. The proof press, use and care
   b. Use and care of brayer
   c. Inking
   d. Pulling the proof
   e. Cleaning type
   f. Use of spaces and quads
   g. Safety with solvents and rags
4. Reading of the proof
   a. Proofreader's marks
   b. Making corrections
   c. Distribution of type
5. Basic type setting jobs
   a. Setting single lines of type
   b. Setting a name or calling card
   c. Setting proverbs
   d. Setting paragraphs
   e. Straight composition
   f. Setting poetry
   g. Indentations
   h. Name lists and team lineups
   i. Display forms: stationery, family, business, personal

E. Operation of the platen press

1. Platen press lockup
   a. Approved methods of handling type
   b. Arranging furniture and quoins within chase
   c. Use of planer
   d. Tightening and testing for lift
   e. Safety practices

Demonstrate the proofing process showing all students how to apply and spread the ink on the plate, ink the type to be proofed, and draw the proof. (References: 1, 3, 6, 7, 8, 9, 12).

Stress the importance of cleaning type after proofing and cleaning the proof press and brayer at the end of the class period. (References: See Safety Section).

Show students how to check type for distribution in its correct case by comparing size, face, width, and nick with the type already in the case.

Emphasize the importance of careful handling of type when removing it from galley or stick for distribution and remind students of the confusion and errors caused by careless distribution and mixing of type sizes.

Use the shop bulletin board or other adequate display area to exhibit good examples of the basic type setting jobs expected of each student.

Require students to develop reasonable skills in typesetting and distribution, after proofing, in preparation for setting up jobs for the platen press.

Demonstrate the method of removing a corrected job from the galley by sliding it onto the imposing table in preparation for lockup. (References: 1, 3, 6, 7, 8, 9, 10, 11).

Show students how to place the chase, measure the job, and place the wood furniture around the form.

Demonstrate the correct method of filling out the form with furniture, reglets and placing the quoins. (References: 1, 3, 6, 7, 8, 9, 10, 12).

Show students how to plane the form after the quoins have been lightly tightened. Stress the importance of "planing" before the form is tightened and tested for "lift."

Demonstrate how lines are tightened if the form does not "lift."

remove type from the galley, place furniture correctly, and lock up the various types of jobs commonly encountered in the print shop, such as small jobs, one and two page jobs, as well as stationery and forms and charts

run a complete job on the platen press and become familiar with all operations from the makeready procedure and inking, the feeding and handling of the printed material, through the removal of the job and cleaning of the press after the run

observe safety habits when working with the press, such as wearing proper clothing and giving strict attention to press operation

develop an understanding and an appreciation of the basic principles of good typographical design

2. Common methods and types of lockup
    a. Small jobs
    b. Single page
    c. Two page
    d. Envelope and stationery corner lockup
    e. Forms and charts

3. Basic platen presswork
    a. Preparation of press
    b. Sequence of makeready operations
    c. Putting the job on the press
    d. Inking the press
    e. Makeready procedure
    f. Handling blank sheets
    g. Feeding the press
    h. Safety rules
    i. Handling printed sheets
    j. Removing the job
    k. Cleaning and care of the press

F. Typographical design

1. Purpose of display
    a. Principles of display
    b. Styles
    c. Balance, harmony, contrast, proportion, interest, lines of flow and spacing
    d. Uses of contrast

2. Color printing
    a. Color theories and effective use of color
    b. Color harmonies
    c. Color contrasts

Familiarize students with the lockup procedures employed for a variety of jobs, such as small jobs, single and two page jobs, corner lockup and lockup for forms and charts.

Provide students with a variety of job lockup problems and give individual help when necessary so that students develop reasonable skills in lockup procedures. (References: 1, 3, 6, 7, 8, 9, 10, 12).

Familiarize students with the terminology used in reference to the principal parts of the platen press.

Instruct small groups in the operation, lubrication, and cleaning of the platen press.

When the instructor feels the students are adequately familiar with the operation, care and safety rules governing press operation, he will demonstrate the procedure of "dressing" the platen.

Show students how to replace the packing and the drawsheet.

Demonstrate inking the press, locking the chase in the bed, and adjusting the position of the grippers. (References: 1, 3, 6, 7, 8, 9, 10, 11).

Show students how to put the press in motion and "pull" the trip lever to place the press on impression.

Instruct students in the method of adjusting the packing to give the correct amount of impression on the drawsheet, and explain why over-packing will result in poor impressions and may damage the type.

Demonstrate the method of locating a sheet of the stock to be printed over the impression on the drawsheet and the placing of the gauge pins.

Impress students with the importance of double checking the locations of the grippers and gauge pins to be sure they will not come in contact with the form when an impression is made.

Illustrate what constitutes a good legible impression and explain how impression is controlled by adjustment of the packing and varying the amount of ink on the disk.

Re-emphasize the importance of cleaning the type, the press, and distributing the type from the form after it has served its purpose.

see good examples of typographical design to help them cultivate and establish good standards of judgment in making layouts

understand the operating principles of the high speed rotary and cylinder presses

have practical instruction to develop appreciation for the art of engraving, etching, and the making of wood cuts

develop skills in the engraving process, using the basic engraving tools with linoleum, wood, or soft metal sheets

develop creative abilities in designing artistic subject matter for linoleum and wood cuts

3. Making of layouts
    a. Purpose
    b. Procedure
    c. Basic sketches
    d. Making of a working layout
    e. Application of typographic design and display
    f. Selection of type sizes and measures
    g. Relations of type faces to stock

G. High speed presses

1. Cylinder presses
    a. Drum press
    b. Two revolution press
    c. Stop cylinder
    d. Perfecting of press

2. The rotary press
    a. Operation
    b. Making of the stereotype matrix and finished plate
    c. Offset printing

H. Engravings, woodcuts, and etchings

1. Materials for engraving
    a. Linoleum blocks
    b. Wood blocks
    c. Metal plates

2. Engraving tools (gravers)
    a. Tools for linoleum and wood
    b. Metal plate gravers

Explain to students the purposes a "layout" serves for the printer and point out the similarity of a layout and a blueprint or working drawing used by a carpenter or other craftsman.

Exhibit a number of finished layouts to the class and lead a critical discussion of their merits, covering such points as emphasis, continuity, balance, and contrast. (References: 1, 3, 4, 6, 7, 8, 9, 12).

Have students make their own layouts, lead a class discussion of the merits of the layouts, and encourage them to make their own suggestions for changes and improvements.

Explain the effective use of colors in printing and present examples of color printing which will tend to develop appreciations in students for excellence of workmanship and effective color use in illustrations and advertising. (References: 3, 4, 6, 7, 9, 12).

Organize a field trip to a modern printing establishment, such as a newspaper or printing establishment where modern high speed press operation may be seen. (References: See Field Trips).

Use wall charts and other visual aids, as well as textbook reference material, to develop some understandings of the operation of high speed presses of different types as used in the modern printing plant. (References: 3, 4, 6, 7, 8, 9, 12).

Demonstrate the methods and tools used to cut a linoleum block and explain the similarity of the linoleum block carving techniques to the woodcuts used for illustrations by the old time printers. (References: 1, 9, 10, 11).

be familiar with the steps involved in the etching process, develop skill in the use of the etching tools, and know the proper way to mix and handle etching fluids

develop habits of safety in the use and handling of etching tools and chemicals

develop basic understandings of the processes involved in the making and preparation of plates for the photoengraving, rotogravure, and lithograph processes

develop an understanding of the importance of illustration in the printing and advertising industry and understand the vast number of employment possibilities

3. Application of designs
    a. Preparation of surfaces
    b. Reversing the design
    c. Holding the work
    d. Use of the gravers

4. The etching process
    a. Metal plates for etching
    b. Acid resistant coatings
    c. Design application
    d. Etching tools
    e. The acid etching process
    f. Safety rules

I. Photoengraving, rotogravure, and lithography

    1. Photoengraving and half-tone plates
        a. Photographic equipment
        b. The crossline screen
        c. Developing process
        d. Etching the plate

    2. Color half-tones
        a. Making separate color plates
        b. Use of filters for photographing separate colors
        c. Printing procedure with color plates
        d. Black in plate

    3. Line etching
        a. Preparation of glass photo plates
        b. Stripping and reversing process
        c. Exposing the sensitized zinc plate
        d. Etching process
        e. Mounting and routing the plate

Encourage students to design an illustration for a letterhead, program, poster, or greeting card.

Explain the process of etching metal plates with acid for producing plates for printing. (References: 1, 9).

Exhibit examples of photoengraving, rotogravure, and lithography and explain the processes used in each of the various methods so that students have some understanding of the steps involved in producing illustrations for the printing press.

understand the great strides which have been made and are being made in the area of color printing

study the silk screen process and note its many industrial and display applications

develop skill in the making of silk screen stencils and in silk screen printing

understand the commonly used types of duplicators

become familiar with the tools and processes involved in the making of stencils for use on the mimeograph machine

understand the great number of employment opportunities existing in the field of duplicating services

J. Rotogravure and photoengraving

   1. Intaglio

      a. Production of original copy
      b. The photographic processes: tone copy and line copy
      c. The etching process
      d. The rotogravure printing process
      e. The color process

K. Silk screen process

   1. Silk screen frame, squeegee, and inks

      a. Stencil cutting
      b. Application of stencil
      c. The silk screen printing process
      d. Cleaning and care of screen, frame, and squeegee

L. Duplicator processes

   1. Spirit duplicators

      a. Carbon sheets for making the reverse copy
      b. Solvents used for duplicating

   2. Gelatin film machines

      a. Gelatin mixes used
      b. Types of indelible inks and carbon papers

   3. Stencil duplicators - mimeographs

      a. Stencils used
      b. Inks and paper used

   4. Photo Copy

Demonstrate the intaglio printing process to students by incising a thin vinylite (plastic) sheet with a needle. The process is effective for demonstration because the transparent vinylite makes the pattern easy to trace, and no dangerous acids are needed to etch in the lines. Print the plate by thinning the regular printers ink with oil before applying and wipe plate with a folded paper towel before printing.

Demonstrate the silk screen printing process and describe its versatility and low cost for printing on a wide variety of surfaces. (References: 1, 9).

Familiarize students with the great variety of duplicating devices available for turning out copy in large quantities with limited facilities.

Use school equipment, if available, to demonstrate the operation and care of mimeograph, spirit, and gelatin duplicators.

Provide opportunity for students to gain operating experience with duplicators by rendering service to the school.

be familiar with the process of padding for binding unfolded sheets, such as bills, application forms, memo pads, and scratch paper

understand the operation of stapling and stitching machines for binding pamphlets, booklets, and books

be able to assemble, staple, end or saddle stitch, and cloth tape a book or booklet

be able to back a book and attach the super and the head bands

prepare and fit the casing and "hang the book"

acquire comprehension of the chemical processes and changes involved in exposing, developing, and fixing photographic film

develop skill in the operation of a camera, read a light meter, and set camera for correct exposure

M. Bookbinding

1. Padding compounds

2. Stapling and stitching

    a. Hand staplers
    b. Power staplers
    c. Stitching machines
    d. Application of tape backing

3. Signature binding

    a. Folding and assembling the signatures
    b. Clamping and sawing the signatures
    c. Sewing the signatures
    d. Clamping and applying padding compound
    e. Applying the end papers and trimming the book
    f. Rounding and backing the books
    g. Attaching the super and headbands
    h. Preparation of the binders, board, and bookcloth
    i. Securing of the book and the casing
    j. Final pressing and cleaning up

N. Photography

1. Light sensitive materials

    a. Films and plates
    b. Photographic papers

2. Cameras

    a. Simple pinhole and box cameras
    b. Complex cameras with compound lenses and shutters

Enumerate and illustrate some of the basic binding processes, such as padding, stapling, stitching, and hand binding of printed material. (References: 1, 5, 7, 9).

Provide students with opportunity to render school service and acquire some experiences in folding, assembling, and stapling or stitching work books, bulletins, school newspapers, and similar printed or duplicated material.

Demonstrate the procedures involved in making a book from folding and sewing the signatures through trimming and "hanging" the book in the casing.

Supplement the book making demonstrations with visual material and a field trip. (References: See Visual Aids, Field Trips).

Provide the simple basic equipment necessary for hand bookbinding so that the more able student may gain some experience in the process. (References: 1, 5, 7, 9).

Conduct a camera clinic and discussion for the class, using available student equipment to demonstrate good picture taking techniques.

Organize a camera club for interested students.

Suggest photographic services for the school newspaper.

develop skill in darkroom techniques in developing photographic film and making simple contact prints

understand the importance of paper making in the graphic arts industry, as well as its importance in other industries, for packing, shipping, building and insulation

understand the process of paper making.

3. Light meters for determining exposure

4. Photo processing

    a. Developing and fixing of films
    b. Printing of negatives by contact
    c. Enlarging process
    d. Developing, fixing, washing, and drying of prints

O. Paper making

1. Hand made paper

    a. Preparation of pulp
    b. Smoothing of the mixture
    c. Dipping of the dickle and mould
    d. Blotting, drying, and sizing of paper

2. Machine made papers

    a. Types of pulp
    b. Operation of the Fourdrinier paper machine
    c. Grade of paper

Demonstrate the operation of the simple pinhole camera and explain or demonstrate the photographic developing and printing process.

Conduct a classroom demonstration of paper making so that students understand the basic process.

Supplement the paper making demonstration with visual material. (References: See Visual Aids).

SUGGESTED PROJECT EXPERIENCES

Basic exercises in type setting, proofing, single lines, names on calling card, proverbs, paragraphs, straight composition, poetry, name lists, display forms, and stationery. (References: 3, 6, 7, 8, 9, 12).

Making a linoleum block cut. (References: 1, 9, 11).

Etching a metal plate.

Making and running a silk-screen stencil. (References: 1, 9).

Making personalized memo pads.

Binding a book. (References: 1, 5, 7, 9).

Making a pinhole camera. (References: 1).

Making paper. (References: 1, 9).

RESOURCE MATERIAL

Safety: See safety section on storage of flamables and print shop safety.

DEVELOPMENTAL VOCABULARY

body type
brayer
buckram
case (bookbinding)
case, job
centered
character
chase
composing stick
copy
cut
dirty proof
distribution
drawsheet
em
en
engraving
etching
font
form
furniture
galley
gauge-pins
graphic arts
hell box
imposing stone
impression
job press
justification
leaders
leads
ligatures
line gauge
lock up
pi
pica
plate (printing)
platen press
planer type

point system
proof
proof marks
proof press
pulp, paper
quads
quoins
ream
reglets
rule
signature
slugs
spaces
tympan
type-high

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GRAPHIC ARTS

FILMS

The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools, Chicago Board of Education, 1961.

Advanced Typing: Duplicating and Manuscript. Castle Films Dept., United World Films, Inc. (U. S. Office of Education), 1944. 26 min. b&w (X-T-26).

Journalism. Carl F. Mahnke Prod., 1940. 11 min. b&w (X-G-8).

Paper Making. Coronet Films, 1941. 20 min. b&w (X-P-25).

Photography. Carl F. Mahnke Prod., 1946. 11 min. b&w (X-P-7).

Printing. Carl F. Mahnke Prod., 1947. 11 min. b&w (X-P-34)

How to Make A Silk Screen Print. Almanac-Art, 1950. 23 min. b&w (X-H-86).

Art of Hand Screen Printing. Orion Pictures. 10 min. color (X-A-154).

FIELD TRIPS

Chicago Tribune, plant tours conducted Monday through Friday at 1:00 - 3:00 - 7:00 p.m. Call SUperior 7-0100 to make reservations.

R. R. Donnelley & Sons Co., 350 East 22nd Street. Call Loren Carter, Head, Training Division, for information and arrangements. Telephone - 431-8000.

Monastery Hill Bindery, 1721 Belmont Avenue. LA 5-4126. (30 pupils limit) Will arrange a tour if details are given.

Hall Printing Company, 4600 Diversey Boulevard. Pa 5-8000. Call Mr. Wesley K. Lunt, Public Relations Director after 9:00 a.m. for arrangements.

Museum of Science and Industry. Mu 4-1414. For a group of 15 or under, a general tour of one hour can be taken care of at any time; for a group of more than 15, a day's notice must be given.

UNIT III: LEATHERWORK

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Leatherworking industries
develop background understandings of the uses of leather in early times for clothing, shelter, weapons, and parchments for recording history	1. History of leather a. Early uses for clothing, weapons, and parchments for writing
learn about the craft guilds, their organization, and control of the leather workers' apprentices to secure standards of workmanship	b. Craft guilds of the middle ages c. History of tanning processes used in ancient times and the processes used by colonists and Indians in America
learn about the primitive methods of tanning and processing developed by the American Indians and the colonists in this country	d. Leather tanning development in the nineteenth century
understand the economic importance of leather as an industrial material used for shoes, clothing, upholstery, luggage, and coverings	2. Modern leather industries a. Sources of leather b. Kinds of animals c. Modern tanning and processing methods
	3. Leather for craft work a. Kinds b. Weights and grades c. Leathers for tooling and carving d. Nontooling leathers e. Lining leathers f. Glove leathers

SUGGESTED LEARNING EXPERIENCES

Lead a discussion about the many uses man had for leather and hides before the advent of fabrics and papers.

Plan a field trip to the Chicago Natural History Museum to see first hand, some of the many uses man has made of leather. (See Field Trips). Contrast the craft guilds of the middle ages to our modern trade unions.

Compare the tanning processes used by the colonists and Indians in America with modern tanning processes. (References: 2, 7, 8, 10). Explain the chrome tanning process and present, examination by students, samples of leather produced by chrome and other tanning processes.

Trace the development of modern leather industries and discuss the many vocational opportunities the industry offers. (References: 2, 10). Discuss and illustrate with maps the principal domestic and foreign sources of hides used for leather goods.

Discuss the importance of leather goods and by-producrs in our modern society.

Explain and display samples of the types of leather used for craft work. (References: 2, 7, 10).

Demonstrate with blackboard sketches or charts the parts of the hide most desirable for tooling and carving, and illustrate the meaning of weights and grades. (References: 2, 7, 10).

Exhibit examples of good design and quality in leather articles and develop some ability on the part of students to recognize good quality, tasteful decoration, and an appreciation for good craftsmanship. (References: 2, 4, 6, 7, 10, 12).

Suggest that students visit leather goods stores or department stores where leather goods are sold in order to develop sound appreciations of value and good workmanship.

know the vocational opportunities existing in the area of leather industries and related crafts

learn the principal types of hides and skins that are used for industry and for craft work

know the principal leather producing countries and the leather producing centers of our country

develop consumer concepts regarding the types and qualities of leather products

recognize the principal types of leather used for craft work, have knowledge of the weight of leather (measurement), and recognize split leathers from top grain

develop skills in the use and care of the leather-cutting tools through practice in cutting and skiving scrap material to avoid waste

develop habits of good craftsmanship and neatness in properly preparing leather for transferring designs accurately in order to maintain high standards of workmanship

4. Opportunities for employment
    a. Chemical research in leather industry
    b. Leather clothing industry
    c. Footwear
    d. Luggage and accessories
    e. Original design and craftwork

B. Cutting of leather
  1. Project planning
      a. Selection of material
      b. Selection of design
      c. Economy in layout
  2. Cutting tools
      a. Care of tools
      b. Knives for cutting leather
      c. Draw gauge
      d. Skiving knife

C. Imposing of designs on leather
  1. Preparation of leather
      a. Sponging
      b. Spraying
      c. Casing
  2. Types of patterns
      a. Tracing paper
      b. Plastic patterns
      c. Outline patterns
  3. Transfer of designs to leather
      a. Placing leather on hard surface
      b. Use of stylus
      c. Pressing in designs from acetate patterns

Encourage students to develop their own designs.

Discuss with students the types of materials best suited to the project they are planning. (References: 2, 4, 7, 10, 11, 13).

Assist students in preparing patterns and in making working sketches so that waste of material will be at a minimum. (References: 2, 3, 4, 7, 8, 10, 12).

Demonstrate the types of knives used for cutting and the importance of keeping leather knives sharp.

Demonstrate the approved methods of sharpening leather knives and give whatever individual instruction is necessary so that each student is able to keep his leather cutting tools sharp. Stress safety procedures in using and handling cutting tools. Point out the types of surfaces on which cutting is done to preserve cutting edges and to prevent damage to table and bench tops. (References: 2, 4, 7, 10, 11, 12). Explain how knife should cut clean without leaving ragged edges and exhibit clean cut edges.

Demonstrate the steps involved in preparing leather for imposing the design.

Exhibit several pieces of leather which have been moistened by sponging, spraying, and casing, and demonstrate the effects of having leather too wet or too dry for pattern transfer and tooling. (References: 1, 2, 4, 7, 8, 10, 11, 12).

Demonstrate the methods of transferring patterns, using outline patterns, tracing paper, and embossed plastic or acetate patterns. (References: 1, 2, 4, 7, 8, 10, 11, 12).

use the tools in making holes in leather for lacing and attaching the various accessories and fasteners

know the wide variety of fasteners, snaps, grommets, buckles, and clasps used to fasten, close, and carry leather articles, and to add to their appearance and utility

be taught to use a variety of surface decorations for leather projects, such as studs, initials, jewels, and spots

D. Punching of holes in leather

1. Awls
   - a. Prickpoint
   - b. Chisel nose
2. Punches
   - a. Hollow-drive punches
   - b. Tube punches
   - c. Combination or lacing punch
   - d. Thonging chisels

E. Use of leather accessories

1. Snaps, rivets, and fasteners
   - a. Birdcage snaps
   - b. Glove snaps
   - c. Heavy duty snaps
   - d. Rivets
   - e. Binding posts
2. Reinforcing devices
   - a. Eyelets
   - b. Grommets
3. Bag accessories
   - a. Clasps
   - b. Locks
   - c. Buckles
   - d. Rings and loops
4. Surface decorations
   - a. Nickel and chrome studs
   - b. Spots and jewels

Demonstrate the use of awls for punching and enlarging holes in leather.

Compare the holes punched with awls and thonging chisels to holes punched with hollow or tube punches and explain the correct use of each. (References: 1, 2, 4, 7, 10, 12).

Display some of the more commonly used leather accessories, such as snaps, locks, rivets, eyelets and grommets, and supervise student demonstrations before the class showing how these accessories are attached to leather. (References: 1, 2, 6, 7, 8, 10, 12).

Explain how pieces of leather ready for assembly by stitching or lacing are held together by cement or glue during the process. (References: 2, 4, 7, 8, 10, 12).

Demonstrate the process, explain the purpose of skiving, and have students practice using the skiving knife on scrap to develop reasonable skill in its use. (References: 2, 4, 7, 8, 10, 12).

develop skills in the assembly of leather parts with the aid of the approved adhesives

develop skill in the use of the spacing wheel, sewing awl, and waxed thread

become familiar with the types of lacing used in leather work and develop skill in lacing techniques

F. Attaching and assembling of pieces of leather

1. Cements and glues
    - a. Rubber cement
    - b. Latex glue (liquid latex)
    - c. Aircraft cement
    - d. Hide glue

2. Sewing of leather
    - a. Using of the spacing wheel or dividers
    - b. Waxing of the thread
    - c. The sewing awl
    - d. Saddle stitch and backstitch
    - e. Sewing of light leather on the standard sewing machine

3. Lacing and tools
    - a. Commercial lacing
    - b. Florentine lacing
    - c. Thongs
    - d. Lacing needled
    - e. Punches for lacing
    - f. Fid awl

4. Lacing procedure
    - a. Spacing the lacing of holes
    - b. Threading of the lacing needle
    - c. Use of the fid awl
    - d. Saddle soap on lacing

5. Lacing styles
    - a. Simple whipstitch
    - b. Florentine stitch
    - c. Running stitch
    - d. Double and cross-whip stitch
    - e. Single overlay stitch
    - f. Double overlay stitch

LEATHERWORK

Demonstrate the process of sewing leather with the back stitch or saddle stitch showing how the spacer is used and how the awl is employed to assist in piercing holes for the needles. Explain why thread for sewing leather is waxed and cite advantages of using some of the new synthetic threads such as rayons and nylon. (References: 2, 7, 8, 10).

Display a number of samples of lacing materials used for decorative lacing and comment on the weaving qualities of lacing made from goatskin, calfskin, and plastic material.

Utilize charts and graphs from reference books as aids to teaching the various lacing styles. (References: 1, 2, 3, 4, 7, 8, 10, 11, 12).

Demonstrate the thong cutter and show students how thongs and lacing may be cut from scrap. (References: 2, 7, 8, 10).

Demonstrate how the skiving knife and aeroplane cement may be used to splice lacing. (References: 2, 7, 8, 10).

Develop some student skills in executing several types of lacing styles and lanyard braiding. (References: 2, 4, 7, 8, 10, 11).

know types of braiding styles, such as used for making lanyards, handles, and similar accessories

develop understanding of the cleaning and coloring processes used on leather surfaces to enhance the appearance of finished articles and know how to clean new leather in preparation for the application of dyes, waxes, and other protective coatings

develop ability to recognize quality in leather and be able to distinguish between surface decorations that are tooled, stamped, carved, or embossed

develop skill in handling the tools used for tooling leather

6. Braiding materials

    a. Commercial lacing
    b. Plastic lacing
    c. Thongs cut from scrap

7. Braiding styles

    a. Flat
    b. Round

G. Cleaning, dying, and coloring of leather

    1. Cleaning and bleaching

    2. Dyes and inks

    3. Shellac and lacquer

    4. Polishes and waxes

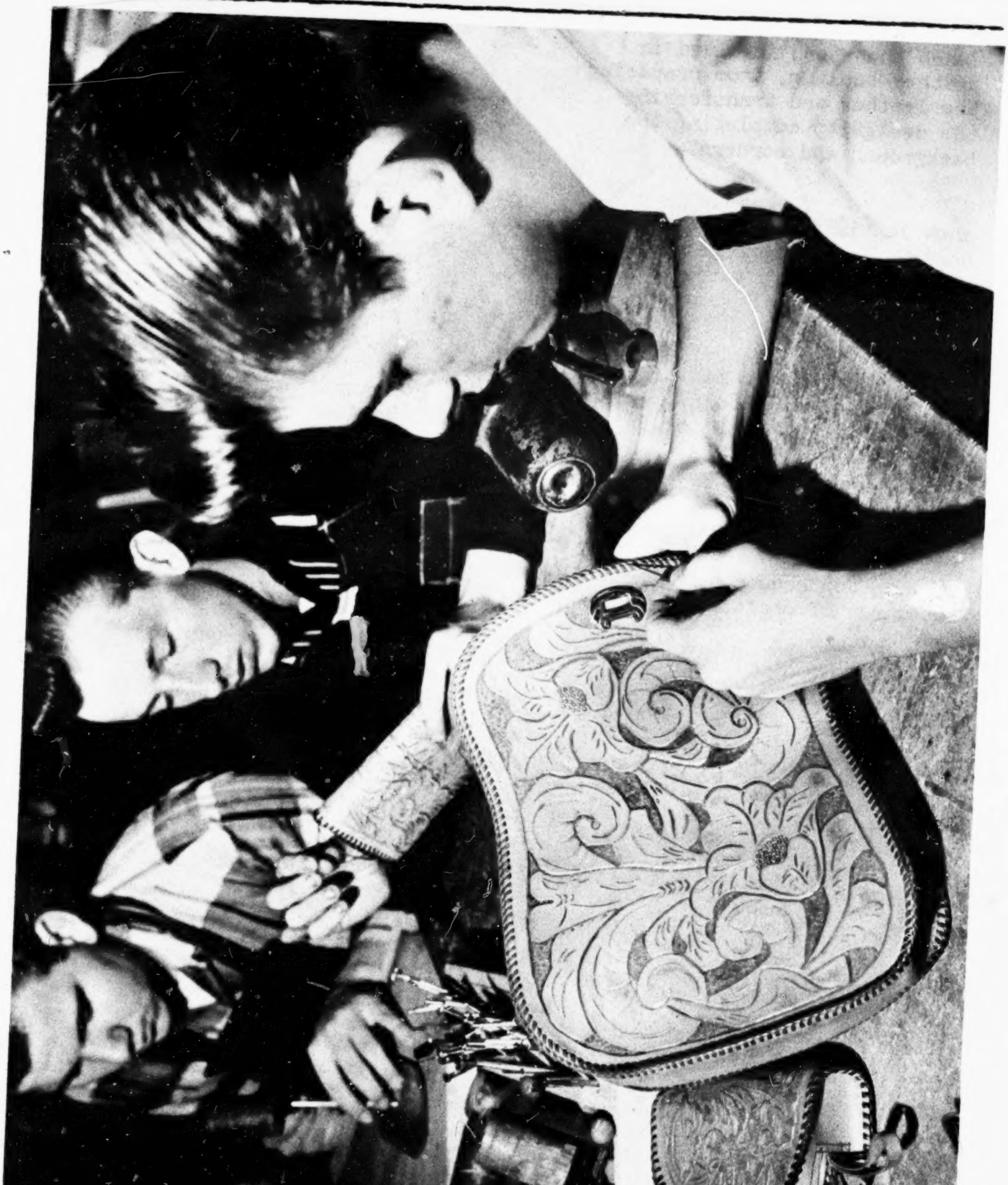
    5. Sun tanning

    6. Burning in designs

H. Tooling of leather

    1. Modeling tools

        a. Tracer
        b. Fine line and spoon
        c. Broad end
        d. Fine line and diamond point
        e. Double ball
        f. Deerfoot
        g. Veiner and round end
        h. Embossing wheel



Leatherwork helps develop appreciations of good quality and encourages high standards of workmanship.

learn the steps involved in leather tooling, from preparing the leather and transferring the design to completing the background and borders

show initiative in working out designs for leather decoration using stamps in a variety of combinations

gain experience in making leather stamping tools, making tracers, and similar tooling devices

develop habits of neatness and precision in leather carving to produce high standards of craftsmanship

2. The modeling or tooling process

    a. Dampening the leather
    b. Tracing the design (tracing tool)
    c. Deepening the design (fine line tool)
    d. Stippling background (point of fine line tool)
    e. Flat modeling the background (broad-end, spoon-end, deerfoot, or diamond point)
    f. Raising or embossing (spoon-end or ball-point)
    g. Embossed borders (embossing wheel)

I. Stamping of leather

1. Commercial stamps

    a. Selection of designs
    b. Use of bevelers
    c. Use of mallet and backing surface

2. Making of stamps

    a. Use of nails or brass rods
    b. Filing of practical designs

J. Leather carving

1. Preparation of leather

    a. Casing
    b. Transferring the design
    c. Paper backing the leather

LEATHERWORK

Exhibit examples of leather projects or sample pieces which have been treated, colored, and dyed, and demonstrate how leather is cleaned, dyed, and finished for use. (References: 2, 5, (Experiments), 7, 8, 10, 11).

Describe and demonstrate the use of the modeling tools and show how the leather is moistened in preparation for tooling after the design has been transferred to it. (References: 4, 7, 8, 10, 11, 12).

Show students how to store leather work during the tooling process. (References: 2, 10).

Demonstrate the use of embossing wheels and stamps for decorating leather surfaces and show students how they make some of their own modeling tools and stamps for use at home. (References: 1, 2, 7, 10, 11).

PROJECTS

Suggested first projects in leather tooling involving cutting, preparing the leather, applying the pattern and tooling: Bookmarks. (References: 2, 10, 11, 12). Luggage tags. (References: 2). Key cases. (References: 2, 10, 11, 13). Belts. (References: 7, 11, 12). Coasters. (References: 11).

Advanced tooling projects include the above operations plus skiving, cementing, lacing, and the use of additional leather accessories. Key cases. (References: 7, 11, 12, 13). Comb cases. (References: 2, 7, 8, 10, 11). Coin purses. (References: 2, 7, 8, 10, 11). Glasses case. (References: 2, 10). Wrist watch straps. (References: 2). Ladies handbags. (References: 1, 7, 10, 11). Wallets. (References: 2, 3, 7, 8, 11, 12). Knife and ax sheaths. (References: 2, 6, 7, 9, 10, 11). Book covers and notebooks. (References: 2, 7, 9, 10, 11). Belts and lanyards. (References: 10, 11). Slippers and moccasins. (References: 2, 9, 10, 12).

Explain the differences in leather tooling and carving and point out the superior wearing qualities and value of carved leather compared to tooled leather designs.

Demonstrate the importance of sharp carving tools and instruct students in the correct methods of sharpening them. (References: 2, 4, 7, 10, 12).

Developing carving skills by having students practice cuts on scrap before attempting a carving project. (References: 2, 4, 7, 10).

develop skill in the use of the camouflage, shading, beveling, and back-grounding tools used to emphasize the carving relief.

2. Carving knives
    a. Swivel top
    b. Swivel tip
    c. Incise knife
    d. Sharpening care of knives
    e. Safety
3. Emphasis on relief
    a. Camouflage tools
    b. Shading
    c. Beveling
    d. Veining
    e. Seeding
    f. Decorative cuts
    g. Backgrounding
4. Finishing
    a. Cleaning
    b. Waxing and polishing

Indicate to students the necessity for careful and accurate design transfer to the leather to produce pleasing symmetrical carvings.

Demonstrate the necessity for paper backing on the leather before carving and tooling so that the leather is not distored or stretched. (References: 2, 4, 10).

Encourage students to develop skills with scrap leather in the use of the tools to emphasize relief.

Supervise the use of the bevelers, shaders, veiners, and seeders, and demonstrate use of swivel knife in making cuts. (References: 2, 4, 7, 10, 12).

Encourage and develop traits of good taste in both design and finish using demonstrations and individual instruction to illustrate good design and finishing techniques. (References: 2, 4, 7, 8, 10, 12).

Advanced projects in leather carving are: Book covers. (References: 7, 10). Belts. (References: 7, 10). Ladies handbags. (References: 7, 10, 13). Holsters. (References: 7, 10). Brief cases. (References: 2, 10). Wallets. (References: 2, 3, 4, 10, 12). Purses. (References: 2, 4, 7, 10, 13). Key cases. (References: 2, 10, 12, 13). Albums. (References: 2, 7, 10). Pocket secretaries. (References: 2, 10).

DEVELOPMENTAL VOCABULARY

alligator skin
background
beveling
buck skin
calf skin
carving
cowhide
double buttonhole stitch
dyeing
embossing
fid awl
finishing
goat skin
lacing
leather
lizard skin
modeling
morocco
ostrich
outlining
pigskin
preparing leather
polishing
punching
saddle soap
seeding
shading
sheep skin
skiving
split cowhide
stamping
suede
template
tooling
tooling leather
top grain
whip stitch

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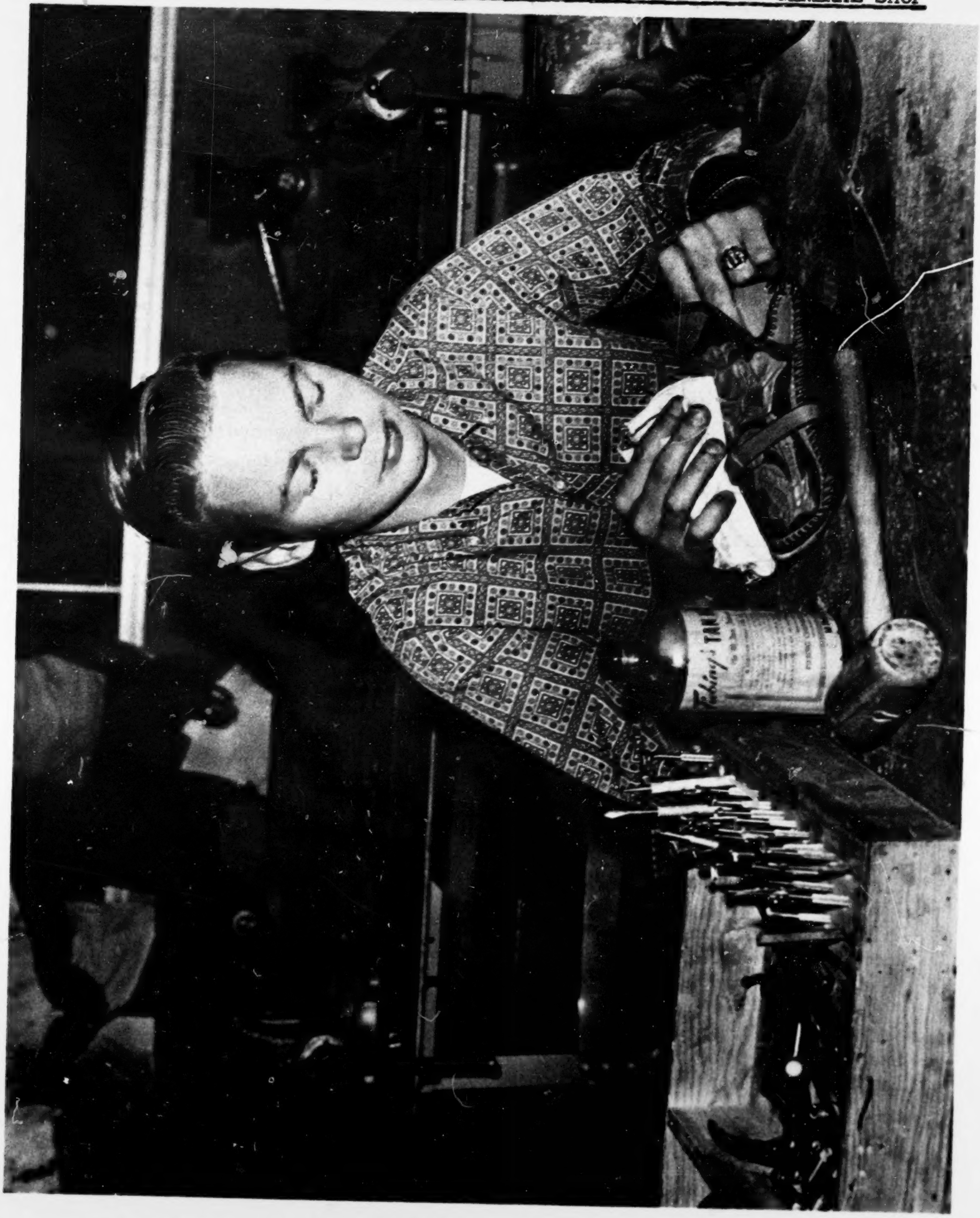

Tasteful surface decorations and careful finishing produce professional quality leather goods.

FILMS

The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools, Chicago Board of Education, 1961.

Art of Leather Carving. Sullivan-Bruce Productions, Inc., 1948. 20 min. color (X-A-111).

Artisans of Florence. McGraw-Hill Book Company, 1947. 20 min. b&w (X-A-106).

Making Shoes. Encyclopaedia Britannica Films, Inc., 1947. 11 min. b&w (X-S-41).

The following films may be ordered from Tandy Leathercraft Co., 182 N. Wabash Ave., Chicago 1, Illinois. Phone: DE 2-4022.

A. Beginners Leathercraft
B. Art of Leathercraft Carving
C. Art of Figure Carving
D. Saddlemaking

No rental or postage charge. Order in advance by mail or phone.

FIELD TRIPS

Bring additional experiences to the student with wisely planned field trips to places where pertinent materials and processes may be observed first hand.

Chicago Natural History Museum. East Roosevelt Road and South Lake Shore. Phone: WA 2-9410.
"Use of Leather by Ancients and Primitives"

Chicago Historical Society. North Clark Street and West North Avenue. Phone: MI 2-4600.
"Uses of Leather in Colonial Times"

Marshall Field and Company. State and Washington Streets. Phone: ST 1-1000.
Leathergoods Department

LEATHERWORK

J. C. Larson Company. 820 South Tripp Avenue.
Phone: SA 2-2810 for an appointment.
Leather Supplies

Florsheim Shoe Company. 130 South Canal Street.
Phone: FR 1-6666 for an appointment.

UNIT IV: METALS

UNDERSTANDINGS

The student should:

develop some background knowledge of the importance of the discovery of metal to man's progress

gain an understanding of man's long struggle to secure, modify, and fabricate metals for use as tools, weapons, and structural materials

develop some basic understandings of the importance of metals and metallurgy in our modern industrial world

realize the vast number of opportunities for employment that exist in the metals industries

acquire reasonable understandings of the various refining processes used to smelt and refine ores to produce steel and other metal alloys used in American industry

OUTLINE OF CONTENT

A. Metalworking industries

1. Early metalworking
   a. Bronze age
   b. Iron age
   c. Early mining methods
   d. Smelting process
2. Modern metal industries
   a. Mining methods
   b. Smelting process
   c. Making steel: Bessemer converter, open hearth, and electric furnace
   d. Production of sheet rods, tubes, and wire
   e. Other important metals and alloys: aluminum, copper, lead, tin, zinc, magnesium, nickel, chromium, tungsten, and vanadium

SUGGESTED LEARNING EXPERIENCES

Discuss the importance of metals to man's existence in our modern industrial society.

Introduce students to historical resource material which deals with man's discovery and early use of metal. (References: 17). Present by lecture and discussion, man's early methods of mining and smelting. (References: 17).

Many excellent examples of man's use of metal for weapons, tools, construction, and decoration may be seen in museums and in illustrations in history books. Such sources of information give the student an opportunity to contrast man's early laborious efforts to wrest ores from the earth and convert their metal content to his use. The student may be surprised to learn the very high degree of skill and craftsmanship developed in the metal arts hundreds of years ago, even though tools and methods of mining were very crude when contrasted with modern industrial processes.

Explain and discuss the modern methods of mining and smelting. Use visual aids to illustrate the principles of smelting, Bessemer converter, open hearth, and electric furnaces (14-17). Supplement the student's learning experiences with field trips to the Museum of Science and Industry, the Chicago Historical Society, Chicago Natural History Museum, South Chicago or Gary Steel Mills (See Field Trips).

Have students make lists of some of the wide variety of metal shapes and forms available to fabricators, such as rods, bars, sheets, tubes, and wire.

Present samples of some of the wide variety of common metals and alloys which are available and used by the metal industries.

Demonstrate the difference in the characteristics of metals, such as malleability, ductility, and hardness.

Give a class demonstration of the spark tests used to determine the hardness of tool steels.

Perform the color-tempering process with a piece of drill rod to indicate how carbon steel may be first shaped and then color tempered for use as a chisel, awl, or screw driver. (References: 4, 23).*

Explain or demonstrate the heat treating process of hardening tool steel and machine parts and illustrate the importance of the process. (References: 6, 14).*

*For the more able student

become familiar with the tools of layout and measurement used by industry to select and prepare metals for cutting and fabrication

develop an understanding of the importance of mathematics in the measurement, layout, and estimation of costs in metal works

B. Measurement and layout tools

1. Ruler
2. Calipers and micrometers
3. Wire gauge
4. Combination square
5. Scriber

Machine lathe operation provides experiences in working metal to exacting tolerances.

METALS

Demonstrate the process of annealing copper, brass, or aluminum to make it more easily worked. (References: 7, 8, 14, 15, 28).

Have students make collections of metal samples and alloy samples and list some of the characteristics of each.

With student participation, perform several experiments with a variety of metal samples, showing some of their characteristics, such as expansion, conductivity of heat, magnetic properties, and corrision rate when exposed to weather. (References: 5, 7, 11, 12, 13, 14).

Explain the importance of layout to students in preparing a piece of work, and emphasize the need for accuracy in computing the material costs and needs.

Demonstrate the correct uses of the layout tools and show students how to lay out a job on metal from a pattern or a drawing. (References: 3, 5, 7, 8, 10, 11, 12, 14, 15).

Have students prepare drawings and patterns necessary for making a simple metal project, such as a metal tray. (References: 3, 12, 15, 16). Have them select an appropriate method of decoration. (References: 8, 13, 14, 15).

Demonstrate an approved method of preparing a bill of material and show students how quantity and cost of material is figured. (References: 22).

Give several practical demonstrations of the methods used to layout irregular shapes and curves on metal surfaces and have students prepare drawings and patterns so that they understand irregular layout procedures. (References: 5, 8, 10, 14, 16, 22).

become familiar with the common hand tools used by the sheet metal worker in cutting, shaping, and assembling metal work

develop good work habits in the shop, observe all safety rules and regulations in handling tools, and develop a co-operative relationship with fellow workers

practice strict observance of safety rules and use of safety guards and devices when operating any type of power equipment

develop reasonable skills with the hand tools used for cutting and shaping metals

develop habits of neatness and orderliness in the handling of shop tools, machines, and materials

C. Hand tools for cutting metal

1. Tinner's snips

a. Straight snips
b. Curved snips
c. Special purpose snips and nibblers

2. Pliers and wire cutters

a. End and side cutters
b. Nippers and bolt cutters

3. Hack saw and blade types

4. Cold chisel types and shapes

5. Safety

D. Making of holes in metal

1. Punches

a. Solid
b. Hollow
c. Center

2. Drills

a. Brace, hand drill, and breast drill
b. Electric hand drill
c. Drill press
d. High speed drills for metal
e. Care and sharpening

3. Safety

METALS

Demonstrate the correct tools to be used in cutting metal in the shop and indicate all safety procedures and precautions which must be followed when using cutting tools. (References: 5, 8, 10, 11, 14, 22).

Supervise student use of cutting tools to assure selection of correct tool and correct work techniques.

Introduce the various hand tools used in the shop for making holes in metal and demonstrate the safe and correct use of each. (References: 5, 7, 8, 12, 14).

Demonstrate the power tools used in the shop for making holes in metal and stress the importance of proper holding of metal during the drilling, as well as other safety procedures to be observed when operating power driven machines. (References: 5, 7, 8, 14).

Give class demonstrations of the proper method of sharpening drills for use in drilling various metals and indicate the necessity of cooling drills during the sharpening process to prevent burning.

Explain and demonstrate the necessity for using lubricants during the drilling process to prevent burning.

Explain what is meant by cutting oil.

develop reasonable skills in the use of the basic tools and materials for metal finishing, such as files, abrasive materials, and buffers

develop skills through experiences with the finishing materials and processes used to protect and preserve metal surfaces

become familiar with the machines used in the sheet metal trades for cutting, folding, and shaping sheet metal

E. Grinding, smoothing, and finishing of metals

   1. Grinding metals

      a. Hand grinder
      b. Power grinder
      c. Types of wheels

   2. Safety

   3. Files and filing

      a. Types
      b. Shapes and sizes

   4. Final finishing

      a. Abrasive cloth
      b. Buffing machine
      c. Lacquer and plastic coats
      d. Electroplating

F. Tools for holding and forming metal

   1. Vises and clamping devices

   2. Mallets

   3. Bench stakes

   4. Hammers

      a. Ball peen
      b. Planishing
      c. Riveting

   5. Handy seamer

METALS

Demonstrate the proper techniques and safety procedures to be followed when using grinding equipment, explain the type of work that may be done on grinders, and select the correct cutting wheels for the various types of metal. (References: 7, 8, 14). Stress the importance of filing and of the selction of the correct file for the job and the material in metal work.

Demonstrate and give individual help to students in developing skills in filing techniques. (References: 8, 13, 14, 22). Make the final steps, involved in finishing metal articles and the protective coats and platings used to protect metal articles from corrosion and wear, an important part of the student's shop experience.

Help students develop an appreciation of good quality and high standards of workmanship as important consumer-information. (References: filing 14, cleaning 3, buffing 14, finishing 3, 12).

Illustrate and explain the process of electroplating as a method of protecting metal surfaces. (References: 12, 13).

Demonstrate the versatility of the machinist's vise as a holding and forming tool.

Point out the many uses of clamps for holding work during the forming, filing, and assembly of work, and stress the necessity for using the drill press, vise, or clamps when drilling metal. (References: 10, 12, 14).

Help students become familiar with the variety of mallets and hammers used by metal workers, and stress the importance of using the correct hammer for the job to be done. (References: 7, 8, 16).

Illustrate the use of the handy seamer for forming small metal parts and show how the grooving tools are used. References: 8, 12, 14). After covering the correct and safe practices used with the hand tools, a variety of projects are suggested to develop reasonable skills in the use of these tools. Projects are made from sheet metal, involving the use of the hand tools and the following processes: preparing layouts, patterns, and bills of material; cutting sheet metal and rod; drilling, annealing, filing, soldering, riveting, decorating surfaces, finishing, polishing, and protecting surface, such as pastry server. (References: 7). Trowels. (References: 6). Metal boxes. (References: 2, 11, 13, 14). Funnel. (References: 5, 15). Bowls and trays. (References: 1, 3, 8). Book-rack. (References: 16), Screwdriver. (References: 6). Tray. (References: 8).

perform manipulative jobs and complete projects designed to develop reasonable skills in the use and operation of sheet metal machines

observe safety procedures in the operation of machines

be provided with necessary equipment and opportunity to develop skills in the use of soldering equipment for joining and fastening sheet metal and to know something of the variety of solders, fluxes, and special alloys available for special soldering jobs

acquire a knowledge of the safe and correct procedures in preparing, using, and caring for soldering equipment

be constantly on the alert for possible fire hazards or other unsafe work conditions that may arise or exist in a shop situation while heat and flammable materials and equipment are being used

G. Machines for cutting and shaping sheet metal, straps, and rods
    1. Shears
    2. Power hack saw
    3. Nibbler
    4. Bar folder
    5. Box and pan break
    6. Rotary machine
    7. Slip roll

H. Equipment for soldering
    1. Torches and heaters
        a. Gasoline
        b. Bottled gas
        c. City gas
    2. Soldering coppers
        a. Electric
        b. Solid coppers
    3. Cleaning tools
        a. Scrapers
        b. Wire brushes
    4. Fluxes
        a. Acid types
        b. Paste and rosin
    5. Solders
        a. Bar and wire
        b. Alloys
        c. Fluxed cores
        d. Special solders for aluminum

METALS

Demonstrate the machines used for cutting and shaping metals.

Give special attention to the safety rules governing the setting and use of the sheet metal shear and supervise its operation. (Shears and potentially dangerous machines should be locked when not in use to prevent possible mishaps.)

Demonstrate the setting and use of the power hack saw and impress upon students that the purpose of the power hack saw is to cut heavy stock and that lighter grades of bar and rod are cut with the hack saw or other appropriate hand tools. (References: 7, 8, 14).

Discuss the variety of jobs performed by the bar folder, box brake, slip rools, and rotary machines, and demonstrate these operations. Individual or small group instruction on these machines is suggested to supplement the general class demonstrations, so that students will understand the operations and be able to acquire some reasonable skills in forming metal parts by machine. (References: 5, 8, 14).

develop reasonable skill in the use of rivets for fastening and assembling metal parts

work with manipulative problems in the shop which will offer practical experiences in the use of metal joining and fastening, using nuts and bolts, taps and dies, and self-threading metal screws

I. Process of soldering
    1. Preparation of the copper for soldering
        a. Shaping and cleaning operations with the file
        b. Heating and tinning methods
        c. Use of salammoniac block
    2. Soldering
        a. Joints
        b. Seams
        c. Sweat soldering

J. Use of rivets
    1. Metal drills
    2. Metal punches
    3. Rivets
        a. Sizes
        b. Setting process
        c. Peening action

K. Machine screws and bolts
    1. Sizes, types and threads
    2. Taps and dies
        a. Relation of drill and tap sizes
        b. Die sizes
    3. Self-threading metal screws
        a. Types and head styles
        b. Relation of screw size to drill size

Carefully demonstrate the soldering process so that students know the type of metal which may be successfully soldered, as well as the types of solder, fluxes, and heat sources necessary to the job. The soldering process is one of the very important operations in sheet metal fabrication. Stress the importance of clean work and clean coppers for strong neat solder jobs. Explain and demonstrate soldering methods, using gas torches for general soldering and sweat-soldering jobs. Stress safety procedures in handling and storing soldering equipment. (References: 5, 8, 14, 20).

Present examples of joints and seams which have been fastened by soldering, riveting, machine screws, self-threading screws, and welding. Use class demonstrations in testing the comparative strengths of the various methods of assembly, so that students will develop some of the judgment necessary in selecting the type of fastening best suited to the job to be done.

Demonstrate the steps involved in riveting, such as selection of rivets, proper drill size, correct hammer, use of rivet set, and methods of backing during the peening and setting processes. (References for riveting, machine screws and self-threading metal screws: 7, 8, 10, 12, 14, 22, 23).

Working in the foundry area develops understandings of the basic principles of metal casting used in industry.

perform jobs involving the welding process for permanently joining metals

develop an understanding of the great number of job opportunities available in the field of welding

use proper safety equipment and wear proper clothing when using welding equipment

become familiar with the correct processes of handling and adjusting gas welding equipment and stress the necessity for constant alertness for all possible fire hazards

L. Welding

1. Oxyacetylene welding
    - a. Safety rules
    - b. Proper apparel
    - c. Selection of tips
    - d. Adjustment of regulators for proper flame
    - e. Fluxes and rods
    - f. Brazing
    - g. Welding of various metals
    - h. Flame cutting
2. Electric spot welding
    - a. Spot welding of sheet metal
    - b. Uses with rod and wire assembly
3. Arc welding
    - a. Safety apparel and masks
    - b. A.C. welders and adjustment
    - c. Selection of coated rods for various jobs
    - d. Arc welding process

METALS

Discuss and demonstrate the versatility of welding in attaching metals of various kinds. The welding processes of attaching metals either by spot welding, electric arc, or oxyacetylene are among the most widely used methods of creating strong metal bonds in industrial plants.

Stress safety rules and safety apparel, selection of torch tips, the setting of regulators, fluxes and rods; demonstrate the correct procedures for welding with the gas torch. Supervise student demonstrations of welding before small groups.

Discuss the many uses of the spot welding process in metal fabrication in small shops and large industrial plants, such as auto body plants where gang welders are used. Demonstrate the operation of the spot welder.

Illustrate the principal differences in gas and arc welded seams and joints, and demonstrate the relative differences and advantages of the two systems of welding. Demonstrate the arc welding process, stressing safety procedures and use of face guards and other safety apparel. (References: 6, 9, 14, 18, 21).

Provide projects which may be used to enrich the metal area involving the use of the tools, materials, and processes already convered. The following are suggestions: Sheet Metal: planters. (References: 2, 11, 13, 14). Trowel. (References: 6). Metal Boxes. (References: 2, 11, 13, 14). Tool Projects: soldering copper. (References: 15). Calipers. (References: 4, 6). Hammers. (References: 4, 6, 7). Cold chisels, punches. (References: 7). Wrought Iron Projects: shoe rack. (References: 22). Tie rack. (References: 7). Wall lamps. (References: 7, 8, 22). Kitchen stool. (References: 4). Telephone table. (References: 4). Jewelry: tie clips. (References: 7). Money clips. (References: 13). Rings, cuff links, earrings. (References: 7).

understand the tremendous industrial importance of all manufacturing processes of the foundry industry

recognize the important relationship of mathematics to the exact measurements and allowance necessary in making foundry patterns and dies for the die casting process

become familiar with the problems that face the foundryman in preparing molds for pouring

gain some practical experience in running a heat and pouring the mold with some of the lower temperature metals, such as lead or zinc alloys, or aluminum

observe the safety procedures to be followed and observed in foundry work

understand how all safety rules and protective clothing are designed for the occupational safety of workers in foundries and industrial plants

have interesting experiences with project material that will amply demonstrate the desirable foundry process, including the cleaning and the final finishing of the castings produced

M. Foundry work

1. Patternmaking

    a. Materials
    b. Shrinkage
    c. Draft
    d. Split patterns
    e. Cores
    f. Match plates

2. Molding process

    a. Preparation of sand
    b. Flask and molding board
    c. Use of the molder's tools: riddle, rammers, bellows, slicks, draw spikes, vent rods, sprue pins, striker, parting sand, etc.
    d. Running of "what" of the heat
    e. Metals and alloys
    f. Safety rules and protective clothing
    g. Metals and alloys for foundry projects
    h. Safety and furnace operation
    i. Pouring process
    j. Cleaning and finishing of castings

METALS

Discuss the importance of the foundry process and related die casting processes to industry.

Display a number of patterns used for molding and explain to students why pattern makers must make provisions for shrinkage, draft, cores, and patterns made in serveral parts. (References: 6, 7, 8, 14, 15, 25, 26).

Explain the various types of molding materials commonly used for casting metals and demonstrate the use of regular molding sand and the process of tempering, cutting, and testing. (References: 7, 8, 14, 15, 16, 25, 26).

Illustrate the molding process by ramming up a mold and pouring it, stressing safety practices in the operation of the furnace and handling of molten metal. (References: 6, 7, 8, 14, 15, 16, 25, 26).

Explain and demonstrate the basic processes used to clean and finish castings. (References: 7, 8, 14, 15, 25, 26).

Select project material suitable for use in adding depth to student experiences in the foundry processes. Use low melting temperature metals, such as lead, antimony alloy, type metal, aluminum or aluminum alloy, or zinc.

In the foundry area, use projects that primarily enrich student experiences in the preparation of molds and the basic foundry processes. The prepraration of one or two simple one-piece patterns may be advisable either as a part of the foundry experience or may well be incorporated into the woodworking area and carried over into the foundry unit.* It is advisable to have on hand a variety of practical patterns or articles that can be used for patterns for student use.

Always consider the limitations and capacity of the available furnace and equipment, and never attempt to operate above safe and practical limits.

Use such forms (patterns) for foundry work as the following: paperweights, letter openers, plaques, trivets, book ends, candle sticks, address numbers, and names.

*For the more able student

develop understandings that will give a good concept of the close relationship between the foundry and the machine process

acquire the basic skills necessary to safe and competent operation of the machine lathe in performing fundamental metal cutting and threading operations

grow in appreciation of the exactness of mathematical tolerance in measurement in the machine processes and the necessity for a knowledge of the practical application of mathematics in machine work and machine design

gain an understanding and appreciation of the accuracy of the machine lathe, milling machine, and shaper, and an understanding of their capacities

develop an appreciation of fine machinery and an understanding and pride in its proper care and safe operation

progress in good shop work habits, cooperative conduct when working with others, and a constant alertness for personal safety, as well as the safety of others, where machines are in operation

N. Machine tools

1. Engine lathe
    a. Safety rules
    b. Operation of the lathe
    c. Tool bits
    d. Selection of turning materials
    e. Thread cutting
    f. Special operations
2. Shaper
    a. Safety rules
    b. Tools
    c. Clamps
    d. Controls
3. Milling machines
    a. Safety rules
    b. Cutters
    c. Clamps
    d. Controls

METALS

Discuss the machine processes, such as the type of work done by operators of machine lathes, milling machines and shapers, and the industrial importance of these jobs.

Introduce students to the machine lathe, and familiarize them with the basic operations.

Give small group instruction on the manual and automatic controls and the basic accessories used on the machine lathe. Cover such basic lathe accessories as tool holders, bits, centers, ejector bar, face plates, dogs, universal chuch, independent jaw chuck, head and tailstock chucks, knurling tool, boring tool, and center drill. (References: 7, 8, 11, 14, 23, 30, 32).

Familiarize students with the precision measuring tools used by the machinist and give individual instruction in the use of the calipers, machinist's square, and the micrometer. (References: 7, 10, 11, 32).

Because of the relative complexity of machine lathe operation, give instruction in small groups and individual instruction before students are permitted to operate the lathe.

Instruct students in the following machine lathe operations: cutting stock, use of dogs, use of chucks, position of cutting tool, automatic feeds, knurling, filing and polishing, drilling and tapping, cutting tapers, boring, cutting threads, and using the precision measuring tools. Stress safety in lathe operation. (References: 7, 8, 11, 14, 16, 23, 31, 32).

Discuss the importance of the shaper in the machine shop, and demonstrate its operation and use. Small group and individual instruction is recommended before students are permitted to use the shaper. Stress safety procedures and demonstrate the controls and adjustments of table, ram stroke and position of stroke, speed, feed, and use, and adjustment of vise, parallels and wedges, tool holder, and bits. (References: 7, 8).

Illustrate how light milling operations may be performed on the machine lathe with the proper acessories. Demonstrate how splines, grooves, keyways, slots and similar cuts are made on the machine lathe with the use of milling accessories. Demonstrate the milling setup on the machine lathe: attachments, milling cutters, use of chucks or collets, depth of cuts, and speed for milling. (References: 30, 31, 32).

develop an understanding of the theory of cutting edges used in machine work, acquire a knowledge of how cutting edges are ground to cut and thread various metals

appreciate the wide variety of products which industry produces through the use of the metal spinning process

become familiar with tools, materials, and machines that give an opportunity to gain some basic skills in metal spinning.

O. Metal spinning

1. Lathes suitable for spinning
    a. Chucks and spinning forms
    b. Tail stock thruss bearings
    c. Tool rest fulcrum pin
    d. Spinning tools
2. Metals for spinning
    a. Nonferrous metals, aluminum, brass, copper, pewter
    b. Ferrous metals
    c. Estimation of size
3. Metal spinning process
    a. Safety rules
    b. Centering procedure
    c. Lubricants
    d. Forming and trimming operations
    e. Annealing process
    f. Beading and finishing processes

METALS

For beginning machine lathe projects use: center punch, drift punch, utility hammer, tap wrench, marking gauge, plumb bob. (References: 11). Ball peen hammer, scriber, tap wrench, paper punch, plastic and metal hammer. (References: 7). Scriber, salt and pepper shakers. (References: 8). Screwdriver. (References: 23).

In addition to the beginning machine lathe projects, seek a few projects which involve several phases of metal work, such as a combination of sheet or bench metal, machine work or the making of a casting in foundry, and the finishing by one or more of the machine processes. Projects fabricated in this manner give the student a better concept of actual production in industry, from raw material to finished product.

Discuss and display some of the many metal products produced by spinning, such as bowls, facings, reflectors, lamp parts, and utensils.

Discuss, display, and demonstrate the types of lathes suitable for metal spinning, as well as chucks, tools, and accessories used to spin metal.

Give a practical classroom demonstration of metal spinning, indicating the types of metal best suited for spinning, and demonstrate the annealing process when metal becomes too tough to work. Stress the safety rules which must be observed when operating the metal spinning lathe. (References: 5, 7, 8, 11, 14, 17, 20).

Use such project experiences as the following for metal spinning: shallow bowls. (References: 7, 12, 13). Pewter dishes, and vases. (References: 8).*

*For the more able student

DEVELOPMENTAL VOCABULARY

abrasive
alloy
anneal
Bessemer
braze
calipers
case harden
chasing
chucks, (medium)
collet
cope (foundry)
cores (foundry)
dogs
draft (foundry)

drag (foundry)
ductile
flask (foundry)
flux
ferrous
gauge
injection
malleable
metallurgy
micrometer
mold
open hearth
peening
planishing

pyrometer
ramming (foundry)
risers (foundry)
raising
scriber
shrinking (foundry)
slicks (foundry)
smelting
spart test
spline
sprue (foundry)
temper
tinning
venting (foundry)

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Drama of Steel. U. S. Bureau of Mines, Graphic Services Section, 1946. 30 min. b&w (X-S-27).

Drilling in Metal, Wood or Plastics. Castle Films, 1943. 23 min. b&w (X-D-13).

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How to Form Aluminum: Blanking and Piercing. U. S. Bureau of Mines, Graphic Services Section, 1944. 16 min. b&w (X-A-32).

How to Form Aluminum: Spinning. U. S. Bureau of Mines, Graphic Services Section, 1944. 17 min. b&w (S-A-39).

How to Form Aluminum: Tube and Shape Bending. U. S. Bureau of Mines, Graphic Services Section, 1944. 14 min. b&w (X-A-36).

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Metal Craft. Encyclopaedia Britannica Films, Inc., 1939. 11 min. b&w (X-A-14).

The Micrometer. U. S. Office of Education, 1942. 12 min. b&w (X-M-42).

The Oxy-Acetylene Flame: Master of Metals. U. S. Bureau of Mines, 1950. 30 min. b&w (X-O-17).

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The Steel Rule. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 10 min. b&w (X-M-41).

Story of Arc Welding: Magic Wand of Industry. Lincoln Electric Company-U. S. Bureau of Mines, 1945. 24 min. b&w (X-W-6).

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Charging and Operating a Cupola. Government Films Dept., United World Films, Inc., 1945. 14 min. b&w (X-C-83).

Making A Simple Core. Government Films Dept., United World Films, Inc., 1944. 15 min. b&w (X-M-107).

Moulding With A Loose Pattern. Government Films Dept., United World Films, Inc., 1944. 21 min. b&w (X-M-108).

Moulding With A Split Pattern. Government Films Dept., United World Films, Inc., 1945. 19 min. b&w (X-M-134).

Preparing A Cupola For Charging. United World Films, Inc., 1945. 21 min. b&w (X-P-65).

Centering Small Stock. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 12 min. b&w (X-M-68).

Countersinking, Counterboring and Spotfacing. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 21 min. b&w (X-M-77).

Cutting A Keyway On A Finished Shaft. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 11 min. b&w (X-M-80).

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Drilling, Boring and Reaming Work Held In Chuck. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 10 min. b&w (X-M-49).

Elementary Operations of the Engine Lathe. Eastman Kodak Co., Informational Films Div., 1941. 22 min. b&w (X-L-6).

Fixed Gauges. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 15 min. b&w (X-M-43).

Fundamentals of End Cutting Tools. Castle Films Dept., United World Films, Inc.-U. S. Office of Education. 13 min. b&w (X-M-72).

Fundamentals of Side Cutting Tools. Castle Films Dept., United World Films, Inc.-U. S. Office of Education. 11 min. b&w (X-M-71).

How To Machine Aluminum. U. S. Bureau of Mines, 1942. 32 min. b&w (X-A-54).

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Laying Out Small Castings. Castle Films Dept., United World Films, Inc.-U.S. Office of Education, 1942. 17 min. b&w (X-M-69).

Locating Holes, Drilling and Tapping In Cast Iron. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 19 min. b&w (X-M-76).

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The Milling Machine. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 6 min. b&w (X-M-50).

Milling Machine Operation. Film Prod., 1941. 24 min. b&w (X-M-37).

Planer & Shaper Operation. Film Prod., 1940. 10 min. b&w (X-P-14).

Precision Gauge Blocks. Castle Films Dept., United World Films, Inc., 1944. 18 min. b&w (X-P-33).

Precision Layout and Measuring. Film Prod., 1940. 10 min. b&w (X-M-23).

Rough Turning Between Centers. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1941. 12 min. b&w (X-M-46).

Turning A Taper With Tailstock Set Over. Castle Films Dept., United World Films, Inc.-U. S. Office of Education, 1942. 18 min. b&w (X-M-73).

How to Weld Aluminum. (Arc) U. S. Bureau of Mines, 1947. 12 min. b&w (X-H-45).

How to Weld Aluminum. (Gas) U. S. Bureau of Mines, 1947. 17 min. b&w (X-H-43).

Inside of Arc Welding: Fundamentals. General Electric, 1942. 10 min. color (X-W-18).

The Welding Operator. Carl F. Mahnke Prod., 1942. 11 min. b&w (X-G-29).

FILMS FROM OTHER SOURCES

List of film libraries are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

1. Bench Metal and Wrought Iron

Cutting Threads with Taps and Dies. U. S. Office of Education, Washington, D. C.

Filing. U. S. Navy Department, Washington 25, D. C.

Fundamentals of Filing. U. S. Office of Education, Washington, D. C.

2. Sheet Metal

Blanking Sheet Metal on the Squaring Shear. U. S. Office of Education, Washington 25, D. C.

Blanking Sheet Metal With Hand Shears. U. S. Office of Education, Washington 25, D. C.

Finish Forming By Hand. U. S. Office of Education, Washington 25, D. C.

Forming On A Hand Operated Brake. U. S. Office of Education, Washington 25, D. C.

Spot Welding. U. S. Office of Education, Washington 25, D. C.

3. Art Metal and Jewelry

Decorative Metal Work. Brandon Films, Inc., 1700 Broadway, New York 19, New York

Hand Soldering. U. S. Office of Education, Washington 25, D. C.

Metal Craft. Encyclopedia Britannica Films, Inc., 1150 Wilmette Avenue, Wilmette, Illinois.

4. Heat Treating

Heat Treating Steel-Elementary Hardening, U. S. Office of Education, Washington 25, D. C.

Heat Treating - Elements of Tempering. U. S. Office of Education, Washington 25, D. C.

FIELD TRIPS

Visits or trips to observe at first-hand some of the processes covered in the metal area should be taken to stimulate the teaching process and enrich the student's experience. Unrelated field trips are generally of little value just as the use of unrelated visual aids have little value as a teaching aid.

Select valuable field trip locations and plan them in advance so that they make a significant contribution to the unit:

METALS

- Ford Motor Company assembly plant
- Local auto body shop
- Local machine shop
- Local welding shop
- Local metal spinning works

UNIT V: PLASTICS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Plastics in industry
understand the kinds of plastics that were available for industrial use a hundred years ago	1. History and development of plastics a. Natural plastics
understand the wide variety of plastics that are available since the invention of celluloid and bakelite	b. Early synthetic plastics: celluloid, casein plastic, bakelite c. Modern plastic materials
	2. Classification a. Cellulose b. Synthetic c. Protein d. Natural resins
	B. Plastics for shop and industrial use
	1. Acrylic plastics a. Characteristics and trade name b. Forms available c. Industrial uses
	2. Cast phenolic resin plates a. Characteristics and trade names b. Forms available c. Industrial uses

SUGGESTED LEARNING EXPERIENCES

Trace the development of plastics from John Wesley Hyatt's discovery of celluloid in 1868 through casein plastic and bakelite in the early part of the 20th century.

Present plastic samples to the class covering the classifications of cellulose, synthetic resin, protein and natural resin, and explain way these plastics may be identified.

Exhibit a sample form of acrylic plastic, such as sheet, rods, tubes, and moulding powders and demônstrate some of the characteristics of the sheet and rod, such as light, transmission, strength, and flexibility when heated.

Perform bending tests with acrylic plastic to give students some concepts of the wide variety of uses to which this material may be put. Bending Experiments. (References: 4).

understand the special purposes to which plastics have been adapted in the electrical, automotive, aircraft, and general industrial areas

understand the wide variety of uses of plastic compounds in treating fabrics for clothing, packaging materials, and impregnating structural materials

understand the chemical composition of the more common plastics and the methods used to manufacture them

understand the structural characteristics of the more common plastics, such as strength, workability, and durability

3. Cellulose acetate plastics
    a. Characteristics and trade names
    b. Forms available
    c. Industrial uses
4. Other important plastics for industrial use and craft work (General Plastics - Cherry - p.   )
    a. Cellulose nitrate
    b. Vinyl resin
    c. Styrene
    d. Urea
    e. Polyethylene
    f. Polyamide
    g. Casein
5. Laminated plastic materials
    a. Impregnated paper, linen, silk, glass fibers, etc.
    b. Laminated plywood

C. Plastic moulding processes
  1. Thermoplastics and thermosetting materials
      a. Compression moulding
      b. Injection moulding
      c. Transfer moulding
      d. Extrusion process

D. Plastic products
  1. Clothing and accessories
      a. Shoe, bags, fabrics, jewelry, toilet articles
      b. Furniture, plumbing, hardware, building materials, roofing, siding, and paints

PLASTICS

Compile a list of the many industrial and craft uses of plastics. Encourage students to make collections or display board of the more widely used plastics, such as acrylics, phenolic resins, styrene, casein, polyethylene, and plastic impregnated materials. (References: 2, 7, 8, 9, 10, 11).

Discuss the plastic moulding processes and explain the industrial uses of compression, injection, transfer, and extrusion. (References: 2, 7, 8, 9, 10).

Lead a class discussion of the many industrial uses of plastic and the probable future influences of plastic products on our daily lives. (References: 2, 7, 8, 10).

be able to select suitable plastic materials for constructing projects

c. Electronic products, automotive fittings, household appliances, tools, containers, toys, safety guards and shields, marine and aircraft products

E. Design and layout

1. Sketching of ideas on paper

   a. Planning construction for strength and appearance
   b. Preparation of working drawings and patterns
   c. Use of squared or graphed paper for irregular shapes and for enlarging designs

2. Selection of material

   a. Selection of materials which can be bent, molded, cemented or machined to meet requirements
   b. Combining of plastics with other materials to enhance design, add strength, and conserve materials

PLASTICS

Display samples of basic plastic projects in which acrylic plastic has been used as the structural material and lead a student discussion of the elements of design of each project. (References: 1, 2, 3, 5, 7, 10).

Encourage students to examine critically the design and structure of plastic projects and embody their own ideas in the creation of new and original designs. (References: 2, 7, 10).

Familiarize students with the large variety of shapes and forms available in plastic stock and encourage individual selection of the best form and material in the creation of new designs. (References: 2, 7).

Lead group discussions in which pupils exchange project sketches and discuss ideas of design improvement to enhance appearance, increase structural strength, and use materials to best advantage.

Demonstrate the process of making working drawing and patterns.

develop skills in the use of the hand tools to saw plastic materials

know the appropriate lubricants to reduce excessive frictional heat

know how to use the square for truing up pieces during the planing, filing, and sanding operation of finishing pieces of plastics to the correct size

3. Measuring and layout tools
    a. Use of masked plastics
    b. Use of unmasked plastics
        (1) Use of scratch awl, dividers, hermaphrodite calipers, marking gauge
        (2) Cementing of patterns to plastic
        (3) Avoidance of scratching lines which will not be removed during finishing

F. Common hand tools for working of plastic
    1. Use of hack saw and back saw
        a. Use of fine toothed blades
        b. Appropriate speed of sawing
    2. The coping saw and jeweler's saw
        a. Use of fine toothed blades
        b. Speed of sawing
        c. Use of lubricants
    3. Use of scissors and tin snips for acetates
    4. Squaring of stock with try square and combination square
        a. Planing
        b. Sanding
        c. Filing
        d. Scraping

Illustrate the use of the measuring and layout tools used for marking plastic in preparation for cutting. (References: 1, 2, 5, 6, 7, 8, 9, 10).

Demonstrate the techniques of making accurate patterns and cementing them to the plastic to avoid unnecessary scratching of the highly polished surfaces. (References: 2, 5, 6, 7, 10).

Demonstrate to students that in general the tool techniques learned in woodworking are very similar to those used in working with plastic. (Review woodworking area.)

Give demonstrations in the use of hand saws for cutting plastic, using fine toothed blades in the hack saw, coping, and jewelers saw. (References: 1, 2, 7, 8, 9, 10).

Indicate the necessity for slow cutting and the use of lubricants to prevent overheating.

Point out the importance of using the try square to keep work on a precision level when planing, filing, sanding, or scraping. (References: 2, 5, 7, 8).

develop skill in the use of drills, taps and dies, drive screws, and self-threading screws in the construction and assembly of plastic materials

develop skill and dexterity in the use of the hand tools used for decorating and enhancing plastic surfaces such as awls and carving tools

5. Drilling, boring, countersinking, and punching
    a. Hand drill and drills
    b. Lubrication with oil or cooking fats
    c. Backing the work when drilling
    d. Clearing bored holes: with cement; with heated rods
    e. Hand punches and solid punches for acetates
6. Taps and dies
    a. Matching drill and tap sizes
    b. Selection of matching tap and die sizes and threads
    c. Use of taper tap, plug tap, and bottoming tap
7. Self tapping and drive screws
    a. Drilling for drive screws
    b. Hole sizes for self tapping screws

G. Surface decorations

1. Grooving
    a. Use of saws and files
    b. Chisels and carving tools
2. Veining
    a. Awls
    b. Carving tools
3. Carving
    a. Wood carving tools
    b. Making of plastic carving tools from old files

Illustrate the process of using the hand drill and lubricated bits for drilling plastic, and show how drilled holes may be kept clear by use of lubricants, a solvent, or a hot metal rod. (References: 1, 2, 6, 7, 8, 10).

Show the similarity of the tool process in tapping metal and plastic. (References: 2, 7, 8, 9, 10).

Show students how to use self-tapping screws and drive screws for attaching metal to plastic or for assembling where high tensil strength is not necessary. (References: 2, 7, 8).

Present a number of examples of surface decoration and demonstrate the tools used for veining, carving, inlay, and overlay. (References: 2, 5, 6, 7, 9, 10).

Exhibit several examples of good surface design and explain to students what features constitute tasteful surface decoration and how "over design" can spoil the appearance of projects. (References: 2, 5, 6, 7, 10).

know the basic heat requirements necessary for forming such common plastic materials as phenolic and acrylic resins and cellulose acetate and be familiar with the heat sources used to form these materials

understand the types of jigs and moulds that are used in industry for forming plastics and for duplicating parts

develop skills in the process of handfinishing plastic surfaces from the rough cut edge to the finished high polish surface

4. Inlay and overlay
    a. Grooving with saw for strip inlay
    b. Pierce sawing with jeweler's saw for irregular inlays
    c. Cutting thin overlay materials from patterns
    d. Cementing

H. Formation of plastics

1. Heating temperatures for forming plastics
    a. Phenolic resins
    b. Acrylic resins
    c. Cellulose acetate
2. Heat sources for forming plastics
    a. Ovens
    b. Infra red lamps
    c. Electric grills
3. Use of jigs for bending
    a. Wood jigs
    b. Pressing into moulds
    c. Forming over makeshift jigs, such as bottles, jars, rods, and bowls
    d. Methods of twisting

I. Finishing of plastic surfaces

1. Files
    a. Shapes and types
    b. Coarseness
2. Scrapers
    a. Steel cabinet scrapers
    b. Glass scrapers
    c. Plane, knife, and chisel blades

PLASTICS

Require students to prepare carefully executed design patterns before attempting to decorate plastic surfaces.

Demonstrate the methods of transferring designs to plastic surfaces or the method of pasting design patterns to the underside of transparent plastic. (References: 1, 2, 5, 6, 7, 9, 10).

Give students individual instruction or small group demonstrations in the use and care of gravers, carving tools, vibrator tools, and high speed grinders used for surface decoration. (References: 1, 2, 5, 6, 7, 9, 10).

understand the methods used to cement plastic parts and to familiarize them with the various types of cements

develop skill in selecting and making some of the common joints used in assembling plastic parts

3. Abrasives
    a. Powdered abrasives and pads
    b. Wet dry papers
4. Buffing
    a. Compounds
    b. Cloth and pad buffers
    c. Waxing (See machine buffing)

J. Cements and solvents
1. Cements for phenolic resins
    a. Preparation of surfaces
    b. Use of dowel pins and clamps to prevent slipping and types of joints
    c. Mixing the liquid resin and acid accelerator
    d. Apllication methods
2. Cementing acrylics
    a. Surface preparation
    b. Clamping
    c. Solvent cements: methylene dichloride, glacial acetic acid (100%) ethylene dichloride, acetone, chloroform and Du Pont H-94
    d. Types of joints
    e. Methods of applying cements: soak joints, brush application, eyedrippers and hypodermic

Introduce students to such plastics as phenolic resins, acrylic resins, and cellulose acetate which may be bent and formed by moderate heating. (References: 1, 2, 6, 7, 8, 9, 10).

Demonstrate one or more of the various heat sources for forming acrylic plastics, such as the plastic oven, infra-red lamp or electric grill.

Set up a number of bending jigs and discuss the use of jigs for duplicating parts and bending conventional and unusual shapes. (References: 1, 2, 5, 7, 8, 9, 10).

Discuss with pupils some of the makeshift forming jigs that can be devised using rods, pipes, jars, trays, and bowls. (References: 2, 5, 9, 10).

Demonstrate the greater flexiblity of acrylic plastics as compared to phenolics and show that the acrylics may be re-heated and reformed if an error occurs in the bending process. (References: 1, 2, 3, 5, 6, 7, 8, 9, 10).

Show student that phenolic plastic may be moderately bent by immersing it in hot water. (References: 2).

Caution students not to attempt bending the acetates with heating methods used for acrylics.

Discuss and demonstrate the processes of finishing plastic surfaces by filing, scraping, wet or dry sandpaper, and hand buffing with F.F.F. pumice, tripoli, and final wax automobile polish. (References: 1, 2, 6, 8, 9, 10, 11).

Re-emphasize the necessity for accurate measurement and squaring of parts in order to facilitate assembly and gluing.

Discuss the various glues and cements used for assembling plastic materials. (References: 1, 2, 5, 6, 7, 8, 9, 10, 11).

Supervise the gluing of a number of kinds of plastic scraps with the various cements and solvents used on phenolics and acrylics and have students test the joints for strength. (References: 4).

Stress the observance of safety procedures when using volatile cements and solvents: use in well ventilated areas and never in the presence of open flame.

Demonstrate the methods of clamping parts in place and applying solvent cements with eyedroppers or hypodermic applicators. (References: 1, 2, 3, 5, 6, 7, 8, 9, 10).

develop skills in mixing and safe use of dyes for coloring plastics

K. Coloring and dyeing of plastics
  1. Preparation of powdered dyes
    a. Mixing fabric dyes with acetone, alcohol and water
    b. Prepared liquid dyes
    c. Use of inks and lacquers
  2. Dyeing process for acrylics
    a. Sanding and polishing operations
    b. Testing for penetration with scrap
    c. Immersing, rinsing, drying and polishing
    d. Safety rules
  3. Cast phenolid resins
    a. Safety procedure for heating dyes
    b. Temperature control
    c. Use of standard dyes
    d. Rinsing and washing with alcohol

understand the laminating process used to enhance the appearance of plastic projects

L. Laminating of acrylic plastic
  1. Preparing laminating dye
    a. Mixing solvent, plastic shavings and dye
    b. Use of prepared laminating dyes
  2. Lamination process
    a. Application of cement
    b. Clamping and drying

Exhibit some samples of clear acrylic plastic which have been dyed and compare the color density and texture with acrylics which have been colored during the manufacturing process.

Demonstrate the dying process and encourage students to evaluate its effective worth as compared to precolored plastic. (References: 2, 7, 8, 9, 10).

Explain the process of laminating clear acrylic and demonstrate the method of mixing solvent, plastic shavings, and dye to produce a laminating cement. (References: 2, 5, 7, 10).

Illustrate some of the refractory effects of laminating clear acrylics with colored laminating dyes.

know the wide variety of industrial plastic products which are manufactured by the casting and moulding process and have experiences in casting and imbedding with plastic

understand that the plastics industry uses machine operations in the production of their plastic products

understand the types of blades and the cutting speeds which must be used when cutting plastic materials

M. Casting of plastic

1. Preparation of castolite
    - a. Adding of catalyst
    - b. Adding of dyes
    - c. Storing
2. Casting process
    - a. Use of containers (moulds) with tapered sides (draft) to permit removal of casting (see foundry moulding-metals section)
    - b. Heating the castolite in the mould
    - c. Process of imbedding articles
    - d. Final finishing of cast pieces

N. Working plastics with machine tools

1. Band sawing
    - a. Safety procedures
    - b. Types of blades and cutting speeds
    - c. Use of lubricants
2. The jig saw
    - a. Types of blades
    - b. Operating speeds
    - c. Use of lubricants
    - d. Internal cuts
3. Circular saw
    - a. Plastic cutting blades
    - b. Cutting speeds

Demonstrate the process of mixing castolite and show students how this material may be used for casting in moulds and imbedding articles for display. (References: 1, 2, 5, 7, 9, 10).

Discuss with students the similarity of the use of machine tools on plastics and wood. (References: See metal and woodworking areas; 2, 7, 9, 10).

Review the safety rules for the operation of all shop machines as set forth in the woodworking and metal areas. Include the operation of the bandsaw, jig saw, circular saw, wood lathe, machine lathe, drill press, sanding machines, and power buffer. (References: See woodworking and metalwork areas).

Illustrate the cutting tools, cutting speeds, and lubricants used with plastics which differ in type and method from those used for metal or woodworking. (References: 2, 5, 7, 9, 10).

use the wood turning lathe for turning plastic materials

know the operation of the machine lathe and its use in machining plastic

know how to drill plastic

know how to sand plastic

know the types of finishes that are used on plastic surfaces

know the use of the vibro-tool and small motor grinders in decorating plastic surfaces

4. Plastic turning on the wood lathe
   a. Turning between centers
   b. Use of chucks
   c. Cutting tools for plastic
   d. Finishing and polishing in the lathe

5. The machine lathe
   a. Safety procedures
   b. Similarity to machining brass (see metal area - machine lathe operation)
   c. Sharpening of bits
   d. Special tools from old files
   e. Finishing and polishing on the lathe

6. The drill press
   a. Safety procedures
   b. Selection of bits
   c. Holding and backing
   d. Use of lubricants
   e. Cleaning and polishing holes

7. Sanding machines
   a. Disk sander and types of abrasive disks
   b. Belt sanders, wet-dry belt surfaces
   c. Band sanders
   d. Combination machines
   e. Safe cutting speeds

8. Power buffers
   a. Types of wheels
   b. Buffing compounds
   c. Avoiding over-heating
   d. Safety rules in buffing

Demonstrate the correct method of using the power buffer and point out the results of prolonged heavy pressure on the wheel with plastics which have a tendency to overheat and deform or burn. (References: 1, 2, 5, 6, 7, 9, 10, 11).

learn the process of internal carving and dyeing of plastic.

9. Internal carving
    a. Using a vibro tool for surface decoration
    b. Small motor grinders
    c. Flexible shaft machines
    d. Internal carving bits
    e. Color blenders
    f. Dyes
    g. Fillers

10. Additional machine operations with plastics
    a. Jointer
    b. Milling
    c. Routers
    d. Shaper

Present a number of samples of internal carving and demonstrate the use of the tapered bits in motor grinders or flexible shaft machines.

Instruct students individually in the use of the internal carving techniques and point out the safety precautions to be observed when carving with the high speed drills. (References: 2, 5, 6, 7, 9, 10, 11).

Demonstrate the application of internal carving dyes, blenders, and fillers and show pupils how opaque plastic backing may be used to conceal the open side of the carving. (References: 2, 5, 7, 9, 10, 11).

Encourage originality of design in internal carving work and discourage excessive decoration.

Lead a discussion of the machine processing of plastics using the jointer, milling machine, shaper, and router. Point out to students that many of these complex processes are not used in industry because of the many shapes and forms that can be produced by the extrusion and casting processes making milling, shaping, and routing unnecessary. (References: 2, 7, 10).

Use photographs, visual aids, and blackboard sketches to illustrate to students some of the special processes used in industry, such as blowing plastic bubbles for aircraft and vacuum molding. (See Visual Aids) References: 2, 7, 8, 9, 10).

Suggested beginning projects made from flat stock: key tabs, light pulls, zipper pulls, rings. (References: 2, 5, 7, 10, 11). Letter openers, coasters, buttons, house numbers, letterholders, shelves, coat hangers, book ends, picture frames, lamps. (References: 2, 3, 5, 6, 7, 9, 10, 11). Salt shakers.

Advanced projects including process of bending, cementing, laminating and surface decoration: bracelets, towel racks, tableware, desk sets, lamps, book ends, plaques, serving trays, boxes, bowls, tie clips, laminated cuff links, laminated photographs, necklaces. (References: 2, 5, 6, 7, 10).

Turned projects: gavels, salt shakers, bracelets, tool handles, candle holders, desk set, doorknobs. (References: 2, 5, 10).

Internal carving projects: salt shakers, paperweights, desk ornaments, clocks, key tabs, jewelry, doorknobs. (References: 2, 5, 6, 9, 10, 11).

Plastic furniture: smoking stand, end tables, coffee table. (References: 5, 7, 10).

Skillful use of the internal carving tool enhances the beauty of plastic articles.

PLASTICS

Castolite projects: preserved specimens, coin displays, lockets, desk ornaments. (References: 2, 10).

Pressure and vacuum moulded projects: bowls, dishes. (References: 9, 10).

DEVELOPMENTAL VOCABULARY

abrasives
acetate
acrylic
bakelite
buffing
casein
catalyst
cellulose
compression molding
crazing
curing
embedding
extrusion
fabrication
friction weld
fusability
injection molding
internal carving
lucite
mandrel
phenolic
plastics
plexiglas
polymerization
resin
resinoid
thermoplastic
thermosetting
synthetic
vacuum moulding
vinyl

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7. Groneman, Chris H. Plastics Made Practical. Milwaukee: Bruce Publishing Company, 1948.
8. Groneman, Chris H., and Feirer, John L. General Shop. New York: McGraw-Hill Book Company, 1956.

9. Newkirk, Louis V. General Shop for Everyone. Boston: D. C. Heath & Company, 1959.

10. Newkirk, Louis V., Hewitt, Coleman, and Zutter, LaVada. Adventures With Plastics. Boston: D. C. Heath & Company, 1947.

11. Willoughby, George A. General Crafts. Peoria: Charles A. Bennett Company, 1959.

FILMS

The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools.

Drilling in Metal, Wood or Plastics. Castle Films Dept., United World Films, Inc., 1943. 23 min. b&w (X-D-13).

FILMS FROM OTHER SOURCES

Kingdom of Plastics. O'Neil-Irwin Co. (Diacro), 300 Eighth Avenue, Lake City, Minnesota. No charge.

Forming Plastic Sheet Material. O'Neil-Irwin Co. (Diacro), 300 Eighth Avenue, Lake City, Minnesota. No charge.

FIELD TRIPS

For field trips to points of interest in connection with plastics visit local and neighborhood industrial plants.

1. The Museum of Science and Industry, East 57th Street and South Shore Drive, has good exhibits of plastic processes and applications. The museum will provide a free guide for groups on any weekday. Make arrangements in advance. Call MUseum 4-1414.

2. The Chicago Molded Products Corporation, 1020 N. Kolmar Avenue, Chicago 51, Illinois. Arrangements should be made at least a week in advance, and by letter.

3. The Molded Products Corporation, Plastics Division, 4533-35 W. Harrison Street, Chicago 24, Illinois. Tours of not more than twelve students under supervision. Make arrangements by mail.

TEACHER'S NOTES

UNIT VI: WOODWORKING

UNDERSTANDINGS

The student should:

acquire information about the locations of the principal forest areas in the United States and Canada

view samples and lists of types of lumber available from yards and develop some understanding of the properties and uses of these materials

survey statistics to gain some comprehension of the vast quantities of wood used, cut, and destroyed annually

consider the importance of conservation, fire prevention, and reforestation

develop understandings of the methods used to cut lumber in the forest areas and the modern methods of conveying it to the mill

develop an understanding of the various processes involved in producing lumber for the consumer, such as sawing, drying, milling operations, and methods of grading and measurement

OUTLINE OF CONTENT

A. Lumbering and the woodworking industry

1. Major forest areas of the U. S.
    - a. Kinds of lumber
    - b. Local sources
2. Foreign sources of lumber
    - a. Sources
    - b. Types
    - c. Uses
3. Reforestation
4. Lumber production
    - a. Making logs into lumber
    - b. Air and kiln drying
    - c. Milling and planing
    - d. System of measurement
    - e. Grading of lumber
5. Common properties of woods
    - a. Grain characteristics and strength
    - b. Workability
    - c. Common uses
6. Woodworking occupations
    - a. Lumberman
    - b. Carpenter
    - c. Cabinetmaker
    - d. Patternmaker
    - e. Wood carver

SUGGESTED LEARNING EXPERIENCES

Illustrate with maps, charts, and other visual materials, the sources of some of the more important woods used for industrial architectural purposes. Have students construct product maps and charts indicating principal areas of lumber production, domestic and foreign, as well as location of processing plants, such as lumber, plywood, and paper mills. (References: 4, 5, 9, 11, 12, 13).

Exhibit samples of the various types of wood; explain structural characteristics; explain, as well as demonstrate, that some types of wood are more suitable for furniture than for building materials.

Use visual aids to supplement lecture materials on the production of lumber, showing how trees are felled, transported, sawn, dried, and delivered to markets.

List and discuss some of the principal by-products of wood, such as rayon, fabrics, paper. (References: 4, 5, 9, 11, 12, 13, 14).

Provide samples that are products of the various methods of sawing lumber at the mill and show students how different methods of sawing effect grain, strength of material, and cost.

Stress the importance of wood as a structural material for building and for industry; develop student interest in preservation of our forests and the national reforestation program.

Supply students with statistical material for discussing and understanding the wide variety of jobs available in the woodworking industry.

Discuss the variety of types of work required in the building of a house, from the lumberman's job in the forest to the carpenter and cabinet maker's work in trimming a house and applying a final finish.

understand the general physical and structural properties of commonly used woods and how these properties affect strength, durability, workability, and usability

compare the great number of people employed in the woodworking industries and the vast number of vocational opportunities existing in the various phases of woodworking and the related wood products industries

study the importance of accurate measurement and use of proper planning and layout in woodworking in order to cut waist and material costs, as well as to produce acceptable standards of quality workmanship

consider the importance of drawings and blueprints, the language of industry, in planning and building anything from a small project to a large building

learn to use the precision tools of measurement and layout

contrast the basic tools of measurement and tolerance used by the patternmaker in preparing wood patterns for the foundryman

take pride in caring for and using good tools

B. Layout and measurement
    1. Drawings, plans, and patterns
        a. Reading drawings and blueprints
        b. Preparing drawings, plans, and sketches
        c. Scale drawings and drawing instruments
        d. Symbols used in drawings
        e. Making patterns and templates
    2. Rules
        a. Calibrations
        b. Shrink rule
    3. Squares
        a. Try square
        b. T-bevel
        c. Framing square
    4. Marking tools
        a. Compass and dividers
        b. Marking gauge
        c. Knife and carpenter's pencil

C. Woodworking hand tools
    1. Tool safety
    2. Knives
        a. Types and uses
        b. Care and sharpening
    3. Hand planes
        a. Types and uses
        b. Sharpening, adjustment, and care
        c. Planing techniques

Explain with practical demonstrations and blackboard illustrations the system of board measure and give students some practical exercises which will enable them to make out bills of material for practical jobs. (References: 4).

Present methods of layout to class so that students are concious of the importance of careful and accurate layout in producing good work with minimum waste and accurate estimate of material cost.

Review principles of mechanical drawing with students so that they will develop some modest skills in making simple working drawings and in bing able to read and work from drawings in the shop.

Note: Students should be able to make up a bill of material from a drawing and to make necessary layouts and patterns for executing the project.

Demonstrate the use of the layout tools with small groups of students so that each one will learn to use the tools accurately. Give special attention to the framing square and its versatility as a layout tool. (References: 1, 4, 5, 11, 12, 14, 16).

Demonstrate the use of the available complement of hand tools to the entire group and then correct and develop skills and techniques with smaller groups and individuals. The woodworking hand tools require group and individual demonstration and instruction.

Note: To develop skills with the hand tools, a selection of projects is submitted below which covers a diversity of project material, sufficiently versatile to appeal to the varied interests of students. Relatively simple jobs may be selected as "starters" until the teacher has an opportunity to discover the various ability and aptitude levels of the students.

As project work is started and developed give ample opportunity to the students to practice in planning, sketching, and making a bill of material and layout.

As the project work progresses, give attention to development of tool skills and safety practices. Encourage students to maintain high standards of workmanship.

form good safety habits in the handling of all tools and machines in the shop

develop cooperative work habits for reasons of personal as well as group safety

compare the close relationships between school shop safety and the safety precautions and rules used in industry for the protection of workers

develop an appreciation for the performance of sharp, well-adjusted cutting tools

develop understandings of the proper use of the correct tool for a specific job

develop reasonable skills in the use, adjustment, and care of hand planes

learn how to select, use, and care for files and rasps for specific jobs

develop reasonable skill performance in the selection and use of hand saws

consider the wide variety of drilling and boring tools available for woodworking and develop some ability in the selection of the correct cutter for the job

4. The spoke shave and draw knife

5. Files and rasps

    a. Shapes and sizes
    b. Correct uses and care

6. Hand saws

    a. Use of the correct saw: coping, back, rip, crosscut, keyhole, and turning
    b. Care and sharpening of saws

7. Boring of holes in wood

    a. Ratchet brace and bits: auger bits, dowel bits, twist bits, expansion bits, countersink bits, forstner bits, screwdriver bits, and depth gauges
    b. Hand drill and straight shank drill.
    c. Atuomatic drills and bits

8. Chisels and gouges

    a. Safe and correct use
    b. Types, sizes
    c. Sharpening and care

9. Hammers and mallets

    a. Claw and tack hammer
    b. Wood, rubber, and composition mallets

10. Screw drivers

    a. Sizes and types
    b. Automatic screwdrivers and bits

WOODWORKING

Provide projects requiring use of hand tools and involving the processes of layout, hand sawing, planing, filing, gluing, and finish. Book ends. (References: 1, 4, 11, 13, 15, 18). Magazine racks. (References: 4, 7, 9, 12, 13, 15, 18). Book cases. (References: 1, 7, 9, 10, 13, 14*, 15*, 17, 19). Wall shelves. (References: 2, 4, 7, 9, 11, 12, 16, 18). Cutting boards. (References: 9, 11, 16). Cutlery holders. (References: 1, 11, 16). Letter holders. (References: 7, 13). Bird house and feeders. (References: 1, 4, 5, 7, 9, 11, 12, 16). Stools. (References: 1, 7, 9, 10, 11, 13, 15*, 16). Boxes. (References: 7, 9, 11, 14*, 16*, 18). Lamps. (References: 7, 9, 15, 18). Trays. (References: 1, 7, 9, 10, 11, 12, 13, 14*, 15*, 16). Picture frames. (References: 10, 15). Shadow boxes. (References: 7. 17, 18). Toys. (References: 7, 11, 16, 18). Games. (References: 4, 11). Tables. (References: 11*, 12*, 13*, 15*, 16*).

*For the more able student

develop good safety habits in the use and care of chisels and gouges

learn the correct uses of hammers and mallets of different types

know how to select and use the correct type and size of screwdriver for the task at hand

know the uses of some of the more common holding devices in woodworking, such as vises, clamps, and hand screws

consider the wide variety of metal fastening devices available for assembling wood and for attaching hardware to wood

compare and select the types of adhesives used in the shop and in industry for assembling projects, plywoods, veneers, and other wood products

consider the wide variety of hardware fittings available for use in the construction of buildings, furniture, and other assemblies using wood and wood products

develop skills in attaching some of the frequently used pieces of hardware, such as mending plates, hinges, locks, and handles

11. Nail sets

12. Scrapers

D. Vises and clamps

1. Woodworking vise

2. "C" clamps

3. Hand screws

4. Bar clamps

E. Common wood fasteners

1. Nails

    a. Types: common, box, casing, finishing, non-corrosive, hardened
    b. Sizes and correct use

3. Corrugated fasteners

    a. Sizes
    b. Uses

4. Dowel rods

    a. Sizes and correct uses
    b. Dowel boring jig

5. Adhesives

    a. Types of glue: animal, fish, casein, urea-resin, polyvinyl-resin, resorcinol-resin
    b. Mixing and application
    c. Correct uses

F. Common hardware fittings

1. Hinges

    a. Butt, screen, strap, piano, surface, door, and chest

Note: In the process of working with the projects for hand tools, the related information on wood fasteners, adhesives and hardware should be covered so that students have adequate information to make intelligent selection and use of these assembly devices. (References: 16).

Set up simple shop experiements to test the holding power of nails, screws, and adhesives. (References: 8).

Give class demonstrations of the methods of attaching hinges and mortice locks, stressing safety procedures and holding techniques in use of chisels. (References: 4, 5, 7, 9, 10, 11, 12, 14, 16).

develop good safety habits and understandings of the safety procedures which must be followed when operating any of the power machines in the shop

develop some skill in the safe operation of the jig saw and understand its adjustments and mechanical limitations

learn how to use the drill press correctly and safely, using proper holding techniques and selecting proper drills, as well as proper drilling speeds

2. Knobs and pulls

a. Door fittings
b. Drawer pulls
c. Cabinet knobs
d. Furniture knobs
e. Chest lifts

3. Catches and latches

a. Cupboard catch
b. Friction catches
c. Box catch
d. Hasps
e. Chain and straight bolt
f. Night latch

4. Plates and braces

a. Mending plates
b. Corner strap
c. Corner plate

5. Miscellaneous fittings

a. Hooks and screw eyes
b. Glides
c. Corner fittings
d. Chest locks
e. Costumer hooks
f. Cover
g. Door checks

G. Use of the woodworking machine

1. The jig saw

a. Adjustment and care
b. Safety operation

2. The drill press

a. Speeds and selection of drills
b. Safe operation
c. Drill press accessories

Discuss the operation of complex machines used for industrial woodworking. Most of these specialized machines are modifications of the basic machines used for woodworking, such as jig saw, band saw, circular saw, sander, lathe, and jointer. The instruction in their operation and use should heavily stress safety. Machines are only as safe as their operator. Students should understand that the use of complex machines for industrial woodworking is necessary to maintain the production schedules essential in modern industry.

Explain the operation of the jig saw and familiarize students with its operation, adjustments, and capacity. The jig saw is one of the more versatile machines found in the school shop and is a piece of equipment often found in the home workshop.

Demonstrate the operation of the drill press, stressing safety, drilling speeds, depth gauge, types of drills and cutters that may be used, and correct methods of holding and clamping materials when drilling. The drill press is another versatile machine and students should be familiar with the variety of operations of the machine.

develop the necessary skills for using the grinder for sharpening the various edged tools used in working with wood

have attitudes of respect and be safety conscious toward, such machines as the circular saw, band saw, and jointer

understand operation of settings, controls, and guards on the circular saw

be familiar with methods and devices used on the circular saw to feed various types of material for cutting

develop safety attitudes so that dangerous machines are never used except by or under the direct supervision of the instructor

develop reasonable skills in the setup and adjustment of the wood turning lathe

acquire reasonable skill in the use of the wood turning tools and develop and rigidly follow sound safety habits when operating any power equipment

develop traits of reliability and dependability in the use of all safety equipment and guards when operating machinery

3. Grinders
    a. Use of safety guards and goggles
    b. Attachments

4. The circular saw
    a. Types of blades
    b. Adjustments for sawing
    c. Special attachments
    d. Use of guards, pushers, and safety devices

5. The band saw
    a. Types of blades
    b. Adjustment for cutting
    c. Operation procedure
    d. Safety rules

6. The jointer
    a. Safety procedures
    b. Adjustment of jointer
    c. Operations performed

7. The wood turning lathe
    a. Essential parts
    b. Turning speeds and adjustments
    c. Centering stock
    d. Turning tools and their uses
    e. Turning procedure
    f. Face plate turning
    g. Safety in lathe operation

Carefully demonstrate the operation of the circular saw. Only very reliable, advanced students may operate the circular saw and only under strict teacher supervision. Class instruction in the use of the circular saw requires most careful demonstration in the use of guards, pushers, and other safety procedures. The circular saw is one of the most important machine tools in the woodworking industry and is one of the most dangerous to operate.

Demonstrate the adjustments of the band saw and stress the necessity for checking all machines before operating. Tolerate no laxity in safety regulations. Stress the danger of operating machines beyond their capacity or of using them for jobs they were not intended to perform. The band saw is another very important woodworking machine for cutting curves, scrolls and even straight cuts. It handles considerably heavier cutting job than the jig saw and must be operated with the most careful observance of safety regulations.

Demonstrate the use of the jointer and emphasize the fact that this is another machine requiring proper adjustment and very careful operation. Students should be made to understand the potential dangers of all machines, and each individual should be made to understand the use of safety devices and guards before being permitted to operate the power tools.

Familiarize students with the controls and adjustments of the wood turning lathe. Demonstrate the complete procedure for centering stock and setting up the lathe to do a turning job. Demonstrate the methods of preparing templates to be used for duplicating turned parts. Use group and individual demonstrations to help students develop reasonable skills in wood turning. Demonstrate the procedure for setting up and turning on the face plate. Recommend use of plastic face shield when turning. (References: 19).

Stress the importance of sharp cutting edges to good craftsmanship. Make students conscious of the importance of keeping cutting edges sharp.

Demonstrate the correct use of the grinder and its accessories for sharpening the cutting tools. Students should learn to use the grinder to reface tool edges when needed. Caution students to keep tool steel cooled during grinding to avoid drawing the temper of the tool.

Demonstrate the use of the oil stone to remove feather edges after grinding and to use the oil stone to renew cutting edges when grinding is not necessary. Always use guards on grinders and use goggles to protect eyes. (References for machine tool techniques: 1, 4, 5, 9, 11, 12, 13, 14, 17, 19).

develop reasonable skill and accuracy in using the layout tools, saw, and plane, to cut a piece of material and square its surfaces to exact size

develop a knowledge of the more common types of joints used in woodworking and know what purposes they serve in various types of wood construction

be familiar with the comparative strength of the wide variety of joints

observe the techniques involved in making the more commonly used joints

H. Basic woodworking techniques

1. Squaring process and cutting to correct size
    - a. Finishing of a surface with the plane and try square
    - b. Squaring of an edge with the surface
    - c. Planing across end grain and squaring an end
    - d. Using the measuring tools, marking gauge, square, and pencil to lay off exact width and length
    - e. Sawing to rough size and squaring off remaining surfaces to exact dimensions with the plane
2. Common joints
    - a. Butt joint: used in rough construction; squared surfaces placed together and fastened with glues and nails, screws, corrugated fasteners, or straps
    - b. Lap joint: used where two pieces of the same thickness cross or meet; lap joints usually nailed and glued; lap joints include half lap, end lap, and dovetail lap
    - c. Rabbet joint: used for fitting panels, flooring, sheathing, etc.
    - d. Dado joint: used in door and window frames, shelving, book cases, etc.
    - e. Miter joint: used for cabinet work, moldings, picture frames, and by carpenters for rafters, etc.

Provide larger and more ambitious projects. With the completion of the introduction and demonstration of the hand and machine tool techniques and some project experience in the use of hand tools, the student should be ready for instruction in the more exacting woodworking processes.

Demonstrate the methods of laying out a piece of stock to exact dimensions, rough cutting to size, and then squaring off all surfaces to exact dimension with the plane.

Show that such techniques are used in cabinet making, scale model work, pattern making, etc. (References: 4, 5, 9, 10, 11, 12, 13, 16).

Familiarize students with the common joints used in woodworking and demonstrate their comparative strengths. (References: 8). Essential in woodworking are the various types of joints used in assembling woodwork to strengthen the construction, as well as to enhance its appearance.

Encourage students to maintain high standards of workmanship in their projects. Individual instruction in the tool techniques at opportune times will help develop tool skills and add depth to shop experience. The following projects are suggested for student construction. The projects suggested have been selected to add depth and enrichment to the tool and machine skills developed thus far.

Turned projects: Lamps. (References: 1, 11, 14, 18, 19). Trays. (References: 1, 7, 19). Stools. (References: 1, 12, 19). Candle sticks. (References: 11, 19). Gavels. (References: 1, 19). Tables*. (References: 6, 11, 12, 15, 18, 19). Bowls. (References: 5, 11, 12, 14, 17, 18).

Furniture: Tables*. (References: 10, 11, 12, 13, 14, 15, 16). Chairs*. (References: 11, 18). Radio and hi-fi cabinets (References: 7, 11, 15). Chests of drawers*. (References: 7, 12). Storage cabinets. (References: 7, 11, 12, 13, 14, 18). Desks*. (References: 11, 15, 19).

*For the more able student

acquaint himself with the many varieties of finishes available for wood surfaces; interior, exterior, and marine finishes, as well as the wide variety used for furniture and cabinet work

understand the importance of meticulous and exacting standards of surface preparation before finishes are applied

use cabinet scrapers in preparing of wood surfaces for finishing and develop some skills in the sharpening of scrapers

become familiar with the various types of hand and power sanding procedures and develop the ability to select the proper sanding grit and method of sanding for the job to be done

gain experience with the process of staining wood with oil, water, or spirit stains to enhance the grain structure of various woods

learn the grain structure of some of the more commonly used wood and know the type of filler best suited to fill the grain of the material being finished

learn how to mix and apply fillers, remove excess filler, and, prepare the surface for final finish application

f. Dowel joints: Used largely in furniture and cabinet work
g. Mortise and tenon joints: used largely in cabinet and furniture construction

I. Wood finishing

1. The cabinet scraper
    a. Use of the rectangular and swan neck scrapers for smoothing wood surfaces
    b. Grinding, honing, and rolling the edges to sharpend scrapers

2. Sandpaper
    a. Sandpaper, garnet paper, and wet dry paper
    b. Sizes of sheets and grades of coarseness
    c. Sanding blocks
    d. Portable power sanders
    e. Heavy duty disk and belt sanders

3. Stains
    a. Oil, water and spirit stains
    b. Application of stains

4. Wood fillers
    a. Use of shellac on close grained wood
    b. Paste filler for open grains
    c. Matching filler after staining
    d. Use of iller as a stain and grain filler
    e. Method of mixing, applying, and removing excess filler

Demonstrate the basic steps necessary to prepare project material for finishing. Have students participate in conducting several durability tests of inside and outside finishing materials. (References: 8).

Instruct students in the correct use of the devices use[illegible] to prepare wood surfaces including the cabinet scraper, as well a[illegible]ne various types of abrasives, used to smooth wood surfaces.

Demonstrate the correct methods of power sanding and stress safety procedures. Present examples of good and poor surface finish and demonstrate the results when finish is applied. Make some classroom tests of abrasive materials or have students give demonstrations of the effectiveness of some of the variety of abrasive papers available for surface finishing. (References for sanding and surface finishing: 1, 4, 5, 7, 9, 11, 12, 13, 14, 16, 17, 18).

Explain and show examples of differences in texture of wood grains and demonstrate the use of stains and fillers to enhance the beauty of the grain and fill the wood pores in preparation for the application of final finishes.

Stress safety procedures to be observed in the use of stain and fillers. Students should be made aware of the fire hazards that exist when volatile liquids are being used in the shop or at home. Stress the danger of spontaneous combustion inherent in rags used for removing fillers and other finishing materials. Develop fire safety consciousness and urge students to observe fire safety regulations in the shop and at home. Display and use U. L. approved containers for volatile liquids and disposal units for oil and paint rags.

understand the importance of safe practices in handling, applying, and storing finishing materials; and the danger involved in storing wiping rags which contain oils and filler material

acquire some background information on the source of shellac, the methods of mixing, and the approved methods of application and rubbing

obtain basic information concerning vehicles and thinners used in the various finishes and type of thinner used to clean brushes

know the importance of keeping finishing area, the work, brushes, and finishing materials clean

acquire some information about the basic ingredients of varnishes, the methods of application, and the methods of rubbing to produce smooth durable finishes for interior and exterior service

become familiar with the operation of spraying equipment for applying finishes, observe the importance of using only approved areas for spraying, and the use of respiratory equipment when spraying paints or lacquers

   f. Safety suggestions for disposition of filler rags and cleaning of brushes and applicators
   g. Final surface treatment before applying varnish, shellac, or lacquer

5. Shellac

   a. Types and cuts of shellac
   b. Use of shellac as a filler and nonwaterproof finish
   c. Application, drying, and rubbing
   d. Storage of shellac and care of brushes

6. Spar varnish

   a. Components of varnishes
   b. Application and drying
   c. Sanding or rubbing between coats
   d. Use of pumice and rottenstone
   e. Care of brushes and disposal of varnish rags

7. Synthetic finishes

   a. Application of lacquer and plasti-coats
   b. Use of spraying equipment
   c. Safety precautions
   d. Undercoatings and finishes over which lacquers and synthetics may not be applied
   e. Safety precautions in using spray equipment and highly volatile liquids

Display or have students prepare sample finish boards showing the finish effects produced by shellac, varnish, enamels, inside and outside paints.

Demonstrate and have students use some of the new plastic and rubber base synthetics and "rub on" finishes.

Demonstrate the cleaning and care of paint brushes and establish a shop routine requiring that finishing materials be properly cleaned and stored after use.

Demonstrate the techniques of spray finishes, using spray cans or power spray units.

Familiarize students in the industrial methods of applying some of the new type of synthetic finishes used on furniture and cabinet work.

Stress the necessity for proper ventilation and use of exhaust fans when using spray equipment.

Demonstrate methods of disassembly of power spray equipment and instruct students in proper care and adjustment of nozzles.

compare the differences between shellac, varnishes, oil paints, enamels, and lacquers and synthetics, and the thinners used for these finishes

be able to select the proper material for the surface to be finished and know why some lacquers and synthetics may not be applied over other primers and finishes

8. Enamels
    a. Color varnishes
    b. Priming coats
    c. Rubbing process
    d. Care and cleaning of brushes
    e. Safety rules

9. Color lacquer and synthetics
    a. Composition
    b. Methods of application
    c. Spray cans and power spraying equipment
    d. Safety precautions and practices
    e. Thinners and vehicles for synthetics

10. Paints
    a. Types of paint finishes
    b. Ingredients and vehicles
    c. Mixing of paints
    d. Surface preparation and priming
    e. Application of paint with brushes, rollers, or sprayers
    f. Brush cleaning
    g. Safety rules

TEACHER'S NOTES

observe the steps involved in refinishing surfaces by removing old finishes and preparing the surface for new finishing material

comprehend that no finished surface will appear any better than the surface appeared before the finish was applied, and that finishing materials will not cover scratches, dents, chips, and similar surface imperfections

learn the more commonly used methods of removing dents, scratches, and other surface defects

acquire factual consumer information concerning the types of brushes, rollers, and sprayers available for applying finishes, in order to help in the selection of the correct applicator and in its care after its use.

11. Refinishing process

    a. Complete removal of old and badly damaged finishes
    b. Use of varnish and paint removers
    c. Cleaning, sanding, sealing or priming surfaces for refinishing
    d. Application of new finish
    e. Cleaning, rubbing, and refinishing surfaces which do not require complete removal of old finish
    f. Removing dents, scratches, burns, and stains from furniture and other painted surfaces

12. Brushes

    a. Types of brushes for various finishing materials
    b. Special brushes for striping, lettering, and special purposes
    c. Paint rollers: their use and care
    d. Care, cleaning, and storage of brushes
    e. Safety in painting

Demonstrate the process of refinishing so that students understand the processes of removing old finish, removal of dents and scratches, and the resurfacing process for applying a new finish. (References on finishing: 1, 4, 7, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19).

Demonstrate the cleaning and care of paint brushes and establish a shop routine requiring that finishing materials be properly cleaned and stored.

DEVELOPMENTAL VOCABULARY

auger bit
back saw
band saw
bevel
bill of material
bits
block plane
brace
butt joint
cabinet making
caliper
carpenter's square
casein
chamfer
chuck
circular saw
clamping
coping saw
corrugated fastener
counter bore
cross cutting
cross lap
dado dra
draft
draw knife
drill press
face plate
fence
filler
firmer chisels
forstner bit
fumed oak
garnet paper
gouge
grain
grinder
half lap
head stock
inlay
interior
jack plane
jig saw
joint
jointer
key hole saw
kiln dry
lag screw
mallet
milling
miter
molding
mortising
mortiser
oil stone
paring
pattern
plywood
rabbet
rasp
reforestation
ripping
router
sander
scraping
scroll saw
shaper
shaping
skew
smoothing plane
solvent
spline
spray gun
steel wool
stock
tail stock
taper
template
tenon
toenail
trammel
try square
turning
upholstery
veneer
warp
whet stone
working drawings

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The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools, Chicago Board of Education, 1961.

ABC of Hand Tools: Part I and II. Gen. Mot.-Walt Disney Productions, 1946. 30 min. color (X-T-43).

Behind the Shop Drawing. The Jam Handy Organization. 22 min. b&w (X-D-17).

Building A House. Encyclopaedia Britannica Films, Inc., 1947. 11 min. b&w (X-B-33).

Conservation of Natural Resources, 1937. Encyclopaedia Britannica Films, Inc. 11 min. b&w (X-C-10).

Essentials of Wood Turning. Bell and Howell, 1941. 11 min. b&w (X-W-17).

Forest Conservation. Encyclopaedia Britannica Films, Inc., 1949. 11 min. color (X-F-89).

Forest Grows. Encyclopaedia Britannica Films, Inc., 1949. 11 min. color (X-F-90).

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Forestry and Forest Industries. Carl F. Mahnke Prod., 1946. 11 min. b&w (X-G-33).

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The Hand Plane. Tompkins Films, 1952. 11 min. b&w (X-H-77).

Hand Sawing. The Jam Handy Organization, 1943. 20 min. b&w (X-S-45).

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Making Glass (For Houses). Encyclopaedia Britannica Films, Inc., 1948. 10 min. b&w (X-M-115).

Painting and Decorating. Carl F. Mahnke Prod., 1945. 11 min. b&w (X-G-34).

The Steel Rule. Castle Films Dept., United World Films, Inc., U. S. Office of Education, 1942. 10 min. b&w (X-M-41).

Use and Care of Hand Files. The Jam Handy Organization, 1942. 20 min. b&w (X-F-33).

Use of Forests. Coronet Films, 1949. 11 min. b&w (X-U-6).

Woodmachining: Turning A Cylinder Between Centers. Government Films Dept., United World Films, Inc., 1944. 17 min. b&w (X-W-7).

Woodmachining: Turning Taper Work. Government Films Dept., United World Films, Inc., 1944. 14 min. b&w (X-W-8).

Woodmachining: Turning Work In A Chuck. Government Films Dept., United World Films, Inc., 1944. 15 min. b&w (X-W-10).

Woodmachining: Turning Work On A Face Plate. Government Films Dept., United World Films, Inc., 1944. 15 min. b&w (X-W-9).

The Woodworker. Carl F. Mahnke Prod., 1940. 11 min. b&w (X-G-12).

FIELD TRIPS

Carefully selected and properly arranged field trips are worthwhile if conducted to places where pertinent and related first hand experiences may be had. Pre-arrangement and reservations are essential to successful field trips. Numerous trips in addition to those suggested below are available in most communities.

1. Museum of Science and Industry, Jackson Park. East 57th Street and South Shore Drive. Phone: MUseum 4-1414.
2. Chicago Natural History Museum. East Roosevelt Road and South Lake Shore. Phone: WAbash 2-9410.
3. Chicago Academy of Sciences, 2001 North Clark Street. Phone: LIncoln 9-0606.

4. Local buildings in process of construction and in various stages of completion. Contact contractor for permission.

5. Local mill. Consult classified telephone directory for location and phone. Contact main office for permission.

6. The Furniture Mart for observing good design. Contact building office for arrangements. 666 North Lake Shore Drive. Phone: SUperior 7-4100.

TEACHER'S NOTES

GRAPHIC ARTS I INTRODUCTION

Instructional units for graphic arts instruction are designed to help students acquire skills, consumer information, technical information, and a deeper understanding of the importance of learning. The scientific and mechanical principles utilized in each printing process are studied along with the source of raw materials and the skills required to produce printed material from each process. Instruction is enriched with demonstrations, class discussions, research assignments, and visual aids.

Safety education is a part of all graphic arts instruction. Special emphasis is placed on developing an understanding of conditions which foster sound safety habits.

Objectives of Graphic Arts Instruction

It is hoped that the following specific objectives will be achieved in addition to the general objectives of industrial arts education:

1. The development of skills and technical knowledge for planning, designing, and printing graphic arts projects
2. The development of interest and knowledge in mechanical principles and the science underlying the graphic arts processes
3. The development of an awareness of the economic, historical, and social significance of graphic arts
4. The development of an awareness of common safety hazards and the importance of safe work practices
5. The development of avocational interests.

Fundamentals of Print Shop Safety

The safety records of commercial shops are generally good. However, school print shops present a variety of problems, such as machines that can cause serious accidents if improperly used; dangers from poor housekeeping habits; incorrect work habits and the handling of heavy objects. Since most accidents are caused by carelessness or lack of proper information, printing students must be well-informed regarding hazards and proper work practices.

A. General safety considerations

    1. Arrangements of equipment for safe and efficient operation

    2. Adequate and safe storage facilities

    3. Students well-informed regarding shop hazards

    4. Procedures in case of injury

    5. Use of accident reports

B. Teacher responsibility

    1. Knowledge of safe shop practices

    2. Recognition and correction of hazards and unsafe practices

    3. Maintainance of good housekeeping habits

    4. Observation of safe shop procedures when introducing students to new operations

C. Student responsibility

    1. Knowledge of machinery mechanism and common tools

        a. Safe speeds and capacity of machines
        b. Purpose of safety devices
        c. Care of equipment and tools

    2. Development of wholesome attitude toward safety program

        a. Mental alertness
        b. Working safely with other students
        c. Accepting safety training as part of print shop instruction

A Typical Composing Room - Hand Composition, Proofing, and Lockup

UNIT I: ORIENTATION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Graphic arts instruction
know the nature and purpose of instruction	1. Application to educational program
know historical background of industry	a. Consumer education b. Avocational possibilities c. Career opportunities
	2. Expanding uses of products
	a. Home b. Industry c. Communications
	B. Historical treatment
	1. Origin and development
	a. Letters b. Alphabet c. Invention of movable type
	2. Early techniques
	a. In Europe and Asia b. During Franklin's time
	3. Equipment
	a. Wooden press
	Size and output
	b. Hand made paper

SUGGESTED LEARNING EXPERIENCES

The primary purpose of graphic arts instruction is to enhance the students' educational experiences rather than to develop vocational competence.

Avocational possibilities are centered in linoleum block printing, wood block printing, silk screen printing, bookbinding and stencil printing.

Have students study early forms of communication and records.

Have students study the materials that were used long ago for purposes of communication.

acquire working knowledge of the science and mechanical principles underlying graphic arts processes

study and compare old methods and present processes

know the purpose and functions of shop organization

develop a cooperative attitude toward participation in the care and proper maintenance of shop facilities

realize the importance of orderly shop procedures in the development of safe and proper work habits.

C. Graphic arts processes

  1. Major processes

    a. Basic principles
    b. Technical characteristics
    c. Main application
    d. Type of equipment

  2. Minor processes

  3. Role of related industries

    a. Paper
    b. Ink
    c. Printer's rollers
    d. Type
    e. Photography
    f. Platemaking
    g. Equipment manufacturers

D. Basic processes and their importance

  1. Materials

    a. Source
    b. Processing

  2. Skills required

E. Shop organization

  1. Student participation

  2. Specific assignments

  3. Duties and responsibilities

  4. Safety program

ORIENTATION

Discuss the modern printing processes and the allied industries:

1. Relief or letterpress
2. Planographic process
3. Intaglio printing
4. Silk screen printing
5. Ink making
6. Paper making
7. Duplicating processes
8. Plate making
9. Bindery operations
10. Photographic processes

Dislay and discuss samples of printing produced by different processes.

Explain duties and responsibilities involved in various shop management assignments.

Stress importance of good planning; craftsmanship; accuracy; and the need for good housekeeping.

Have students inspect equipment and observe safety devices.

List helpful books for reading and reference.

Display and discuss purpose of safety posters, safety rules and special safety devices.

Provide a question and answer period.

F. Instructional procedures

1. Objectives
2. Notebook assignments
3. Teacher demonstrations
4. Tests
5. Grades
6. Resource materials

ORIENTATION

Assign topics for reports about technical and related information:

1. Historical background of graphic arts
2. Invention of movable type
3. Expanding uses of graphic arts products
4. Role of graphic arts in cultural and economic life
5. Graphic arts terms.

(References: 4, 5, 6, 8, 12, 13, 14, 17).

UNIT II: BASIC HAND COMPOSITION

UNDERSTANDINGS

The student should:

develop skills and knowledge necessary for hand composition

set up basic projects as directed in lesson material

extend mechanics of type setting to selected reprint copy

use acquired skills and techniques for setting manuscript copy.

OUTLINE OF CONTENT

A. Introduction to hand composition

  1. Assignments

    a. Work station
    b. Equipment, tools, and material
    c. Storage facilities
    d. Housekeeping procedures

  2. Mechanics of hand composition

    a. Layout of type case
    b. Setting stick to measure
    c. Setting basic projects
    d. Use of leads and slugs
    e. Pulling proof, reading proof, and making corrections
    d. Distributing type and materials

  3. Safety practices

B. Printers system of measurement

  1. Point system

  2. Application to material and tools

C. Typesetting projects

  1. Poetry

  2. Combination of straight matter and leaders

  3. Straight matter and rules

  4. Setting selected reprint job

SUGGESTED LEARNING EXPERIENCES

Demonstrations of handling of equipment, and the use of tools and equipment conforming to accepted practices are important and should occur at stages in the progress of instruction when the need is apparent to both the pupil and the teacher. Practice on the work covered by the demonstration should occur immediately after the demonstration is concluded.

Demonstrate for the students:

1. Handling type case
2. Setting composing stick
3. Removing type from stick
4. Preparing type for proofing
5. Pulling proof
6. Marking proof
7. Correcting type form
8. Distributing type.

Have students set up basic typesetting projects in accordance with printed instructions:

1. Set type
2. Pull proofs
3. Read proofs and make corrections
4. Distribute type form and spacing material.

D. Common problems

  1. Justifying and spacing

  2. Handling type

  3. The demons - puzzling letters

BASIC HAND COMPOSITION

Have students list problems encountered in setting type:

1. Confusing type characters
2. Distributing type
3. Tying type form
4. Spacing and justification.

Have students study and discuss technical topics:

1. Kinds of type
2. Type terminology
3. Fundamentals of design as applied to graphic arts.

Teach and assign basic typesetting projects:

1. Setting single lines of type
2. Setting name card
3. Setting short proverbs
4. Setting a paragraph
5. Setting various indentions
6. Setting selected poems
7. Setting baseball lineup
8. Setting simple display.

(References: 2, 3, 4, 9, 17).

UNIT III: IMPOSITION AND LOCKUP

UNDERSTANDINGS

The student should:

learn how to use and care for equipment and tools

develop skill and knowledge need for imposition and lockup of small forms.

OUTLINE OF CONTENT

A. Equipment and tools

  1. Imposing table
     a. Uses and care
     b. Sizes and styles
  2. Chases
     a. Styles
     b. Sizes
     c. Storage
  3. Tools and material
     a. Furniture
     b. Quoins
     c. Quoin keys

B. Imposition and lockup

  1. Preparation of imposing surface
  2. How to position form on imposing surface
     a. Determining factors
     b. Single page
     c. Envelope corner
     d. Letterhead
     e. Special lockups
  3. Placing furniture and quoins
  4. Planing form
     a. Light form
     b. Heavy form
     c. Pressure of quoins
  5. Testing lockup

SUGGESTED LEARNING EXPERIENCES

All forms that are to be printed must be tightly locked into a metal frame called a chase. The best way to lockup a form will depend upon:

1. The kind and size of press
2. Style of composition
3. Size of sheet to be printed.

Direct students' attention to the proper method for handling and using equipment and tools:

1. Positioning type form on imposing surface
2. Arranging furniture and quoins
3. Using planer and mallet
4. Using quoin key.

Lockup various forms using chaser and overlapping methods.

Display and discuss wall charts depicting common methods of lockups.

(References: 4, 12, 17).

UNIT IV: PLATEN PRESSWORK

UNDERSTANDINGS

The student should:

gain a working knowledge of pressroom procedures, equipment, material, and tools

develop skills and techniques basic to handling pressroom material.

OUTLINE OF CONTENT

A. Platen printing press
  1. Principle parts
  2. Functions of parts
    a. Impression
    b. Inking
    c. Throw-off
    d. Electrical equipment

B. Putting form on press
  1. Preparation
  2. Inking
  3. Packing
  4. Simple makeready
  5. Position and register

C. Feeding the press
  1. Watching color
  2. Correct handling
  3. Common troubles
  4. Oiling and cleaning

SUGGESTED LEARNING EXPERIENCES

Printing is the art or process of impressing type matter or engraving on paper.

Display chart containing names of important parts and discuss their functions. The four basic parts of all printing presses are:

1. The printing unit
2. The inking unit
3. The feeding unit
4. The delivery unit.

Demonstrate proper method:

1. Starting and stopping press
2. Feeding press
3. Handling printed sheets
4. Oiling, and cleaning press
5. Maintaining uniform color.

Have student prepare press for form:

1. Prepare platen
2. Adjust grippers
3. Ink press
4. Place form on press
5. Set guides
6. Print according to printed directions.

List and discuss elements that make makeready necessary.

A Student Demonstration on the Feeding of a Gordon Press

Assign topics for reports about technical and related information:

1. Basic sciences underlying the printing processes and the production of essential materials

2. Mechanical printicples underlying various types of printing presses

3. Printing ink

   a. Composition
   b. Vehicles
   c. Pigments
   d. Compounds and additives
   e. Types of inks

4. Common pressroom troubles.

(References: 9, 12, 17).

Assign topics for reports about technical and related information:

1. Mathematics involved in computing margins

2. Characteristics of wood and metal furniture

3. Funtion of dummy layout

4. Special lockup procedures for automatic presses.

Assign basic projects in platen press lockup:

1. Single page form

2. Two page form

3. Envelope corner form

4. Letterhead form.

(References: 1, 3, 4, 9, 10, 12, 17).

UNIT V: BINDING

UNDERSTANDINGS

The student should:

gain a working knowledge of common bindery operations, equipment, and tools

perform various bindery operations.

OUTLINE OF CONTENT

A. Basic bindery operations and equipment

  1. Cutting and trimming on paper cutter
  2. Folding and various kinds of folding machines
  3. Wire stitching
  4. Mechanical binding in metal and plastics

B. Pamphlet binding

  1. Varieties of pamphlets
     a. Self-covered pamphlets
     b. With separate covers
     c. Saddle stitched
     d. Side-stitched
  2. Mechanical binding
     a. Metal wire binding
     b. Plastic wire binding
     c. Plastic ring
     d. Plastic comb
  3. Loose leaf binding
     a. Card binders
     b. Ring binders
     c. Sectional post binders
     d. Locking expansion back

SUGGESTED LEARNING EXPERIENCES

Binding comprises many highly diversified operations that serve a variety of purposes. Some of these operations are common to most types of binding, others are performed only by very specialized businesses.

Emphasize the need for accuracy and neatness.

Discuss importance of grain direction in bindery operations in paper, cardboards and cover stocks.

Provide graphic arts projects in:

1. Jogging and cutting paper
2. Folding and gathering
3. Making pads
4. Using paper punch and perforator
5. Using wire stapler or wire stitcher.

Display and discuss samples of most commonly used bindings.

Present problems in estimating paper requirements.

Present topics of technical and related information:

1. Paper terminology
2. Factors that govern selection of bindings
3. Safety precautions
4. Show film, How Books Are Made.

(References: 2, 4, 8, 12, 17).

UNIT VI: LAYOUT AND DESIGN

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Layout and design
apply skills and knowledge to projects designed to develop an appreciation for basic principles of design	1. Basic principles of design a. Analyzing copy b. Selecting type and paper c. Determining sizes and measures
note relationship between paper, ink, and design	2. Purpose of layout a. Kinds of layout b. Layout procedures
apply skills and knowledge acquired in setting basic projects to more advanced work	3. Using color a. Theory of color b. Value of color contrasts
	B. Paper
	1. Classification
	2. Selection for specific uses and printing methods
	3. Classifcations of ink
	4. Selection of proper ink
	C. Commercial forms
	1. Principles of display composition a. Review basic principles b. Subordination and emphasis c. Symmetry and balance

SUGGESTED LEARNING EXPERIENCES

The purpose of a layout is to give a definite idea of the appearance of the finished project. It provides directions regarding the job and should leave nothing to guesswork.

Discuss basic requirements for producing printed job:

1. Well-designed type, tastefully arranged or composed
2. Properly inked printing forms, clearly impressed on the paper
3. Paper selected to fit the requirements for the printing process being used and the printing effect desired.

Review leading, margins, and importance of legibility:

1. Type faces
2. Borders, ornaments
3. Arrangement of copy
4. Use of white space.

Discuss simple sketches, rough layouts, and comprehensives.

Study and discuss examples of fine printing.

work out problems involving fitness, page sizes, margins, and areas of type matter

D. Standard sizes of small commercial forms

1. Business cards
2. Letterheads
3. Envelopes
4. Statements
5. Receipts
6. Tickets
7. Miscellaneous forms

LAYOUT AND DESIGN

Have students make rough layouts for a variety of small printing projects. Suggested projects:

1. Identification card
2. Bookmark
3. Admission ticket
4. Program (single page)
5. Business forms
6. Activity posters
7. Linoleum blocks
8. Newspaper ads.

Assign for study topics of technical and related information:

1. Related mathematics
2. Interpreting copy
3. Nature and functions of illustrations
4. Role of photography in modern design.

(References: 1, 2, 3, 7, 9, 12. 17).

UNIT VII: PRINTING STOCK

UNDERSTANDINGS

The student should:

become acquainted with common printing stock

acquire working knowledge of paper terminology

OUTLINE OF CONTENT

A. Printing stocks
    1. Paper
    2. Foils and metallic paper
    3. Binder cloth
    4. Plastics
    5. Sheet metal
    6. Miscellaneous materials

B. Kinds of paper
    1. Book paper
        a. Coated
        b. English finish
        c. Antique
        d. Offset
        e. Machine finish
        f. Sizes and weights
        g. Packaging
    2. Bond papers
        a. Rag content
        b. Sulphite
        c. Sizes and weights
    3. Cardboards
        a. Index
        b. Bristol board
        c. Vellum finish
        d. Sizes and weights

know how paper is manufactured

4. Cover paper
    a. Kinds
    b. Colors
    c. Sizes and weights

5. Special papers
    a. Blotters
    b. Tympan
    c. Sizes and weights

6. Grain
    a. Significance
    b. Determining direction

C. Papermaking

1. Types of fibre
    a. Natural fibres
        (1) Ground wood
        (2) Rag pulp
    b. Chemical fibres
        (1) Sulphite and sulphate pulp
        (2) Bleached and unbleached pulp
        (3) Book pulp
        (4) Kraft pulp

2. Papermaking machines
    a. Hollander
    b. Jordan
    c. Fourdrinier
    d. Stock preparations
        (1) Coating
        (2) Embossing
        (3) Standard finishing
        (4) Converting

SUGGESTED LEARNING EXPERIENCES

Paper is usually the largest single purchase item in printing jobs and exists in a bewildering variety. It is made for hundreds of different purposes, printed in many different processes, and subjected to many different finishing operations after printing.

The term "paper" had its origin from the papyrus plant which was first used by the Egyptians who split the stalk of the plant and fastened the layers together to make a sheet. The first paper mill was erected in England in 1498, and the first mill in this country was built near Philadelphia in 1690. Both of these made paper by hand on a large scale.

Display the different kinds of paper.

Discuss the differences.

Have the students determine the uses appropriate for the various kinds.

Have students develop a "dictionary" of paper terms.

PRINTING STOCK

Cite some basic sizes and weights of paper that is used in school print shop.

Solve some applied problems in paper estimating.

Solve applied problems in spoilage allowance.

Design topics for the study of technical and related information:

1. Paper and its role in printing

2. Other stocks used for printing

    a. Binder cloth
    b. Paperboards
    c. Sheetmetal
    d. Foils and metallic papers
    e. Plastics.

(References: 1, 2, 4, 9, 12, 16).

acquire working knowledge of paper arithmetic for estimating paper requirements

review standard sizes.

D. Paper terms
    1. Brightness
    2. Opacity
    3. Strength
    4. Folding qualities
    5. Picking
    6. Grain
E. Paper arithmetic
    1. Substance figure
    2. Basic size
    3. "M" figure

TEACHER'S NOTES

UNIT VIII: INKS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Printing inks
become aware of the important role of ink in the printing process.	1. Nature and function
	2. Composition
	a. Vehicle b. Pigment c. Drying oils
	3. Primary physical properties
	a. Consistency b. Drying c. Permanency
	B. Inkmaking
	1. Raw material
	2. Grinding or milling
	3. Mixing
	4. Packaging

SUGGESTED LEARNING EXPERIENCES

Regardless of the printing process used, ink is the eseential ingredient in the process. The words we read, the pictures we see are reproduced through the medium of printers ink.

The perfect printed impression requires putting an exact amount of ink on the form and taking it all off with each impression. The exact amount of ink needed is determined by the receptivity of the paper. The amount of ink needed for each impression can be controlled mechanically with adjustable ink fountains.

The variables which cannot be controlled by the mechanics of the press, are those having to do with adjusting of the exact height of the type face to the paper.

Gather printed samples of paper with plastic coatings, glassine, wax paper, and cellophane for comparison with book and magazine printing.

Cite some pressroom troubles which can be due to ink used.

Assign topics for reports about technical and related information:

1. The nature and function of printing inks
2. Composition of ink
3. Main types and classifications
4. Fitting ink to paper and press
5. Ink mixing and color matching
6. Special classes of ink
7. Printing ink terms

(References: 4, 6, 9, 10, 12, 16).

UNIT IX: BLOCK PRINTING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. History of block printing
be given opportunities to develop and practice creative block printing	1. Wood
	2. Linoleum
experiment with addition of color or tent block to enrich appearance of a simple single color job.	3. Rubber
	4. Use of block prints
	B. Preparing blocks
	1. Mounted and unmounted
	2. Attaching
	3. Kinds of wood suitable for blocks
	C. Transferring of design
	1. Tracing directly on block
	2. Offset
	D. Engraving block
	1. Use of cutting tools
	2. Sharpening tools
	3. Care of tools

SUGGESTED LEARNING EXPERIENCES

The teacher should point out that block printing, an old art, is still a popular activity in both graphic arts and art classes. It provides a medium for individual expression and can be useful in making multiple copies.

Making a design for linoleum block printing and transfer the design to the block.

Outline the design and cut linoleum block.

Lock up block in chase and print on platen press.

(References: 11, 17).

E. Printing of the block

1. Proof planer
2. Roller method
3. Platen press
4. Rubbing
5. Stamping

TEACHER'S NOTES

UNIT X: SILK SCREEN PRINTING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Important characteristics
become acquainted with the method of silk screen printing	1. Image carrier porous
	2. Heavy layer of ink
explore various areas in which this process excells over other printing methods	3. Slight pressure
	4. Versatile process used to print and decorate
	5. Individual drying
	B. Three main kinds
	1. Printing of sheets, paper, plastic or other stocks
	2. Cylindrical and conical objects
	3. Webs of fabrics, wallpaper, plastics
	C. Printing
	1. Hand printing
	2. Hand fed presses
	3. Machine fed presses
	4. Automatic presses
	D. Uses and limitations

SUGGESTED LEARNING EXPERIENCES

Silk screen printing like block printing was used centuries ago. This process is essentially one of stencilling and has now been adapted to commercial printing. It is a very versatile process that can be used on almost any kind of stock and even to print and decorate finished objects.

Make a suitable design for silk screen printing.

Trace and cut stencil.

Attach to screen and preface makeready.

Mix ink and print job.

Clean screen and tools.

(References: 6, 13, 15).

experiment with modern methods of making screens and follow same procedure for printing.

E. The main elements in hand printing
    1. Screen
    2. Squeegee
    3. Frame
    4. Drying racks

F. Making stencil
    1. Original drawing
    2. Tracing
    3. Register
    4. Applying paint

G. Materials
    1. Kinds of stencil materials and adherents for each
    2. Screen materials
    3. Solvents and thinners
    4. Inks, masking and block out materials

H. Modern methods of making screens
    1. Tusche method
    2. Direct photographic method

SILK SCREEN PRINTING

TEACHER'S NOTES

The graphic arts project will become more meaningful to the student when he investigates the fields of related knowledge. Pupil participation should be encouraged and assignments should be specific and limited in scope.

Through the media of slides, film, related reading, and charts the student will learn the relationship of good planning, paper, ink, and rollers to the quality of the printed project. In this way shop projects become a point of contact for opening new doors to knowledge, as well as an interesting shop experience.

Have the students study and report on the following topics:

1. Historical development of the graphic arts
2. Impact of printed product upon our civilization
3. Basic sciences underlying various printing processes
4. Source of raw materials used for the processing of various materials used in printing
5. The primary colors
6. Newspaper and magazine printing
7. Rubber stamps, embossing; cutting, scoring
8. Bookbinding processes
9. Career opportunities in the graphic arts industry.

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Inland Printer and American Lithographer. McLean-Hunter Publication, Chicago, Illinois.

Printing Magazine. Walden Sons' and Mott Oradell, New Jersey.

Printing Production. Willsea Publishing Company, Cleveland, Ohio.

FILMS

All films listed below are available gratis on request. In most cases the only responsibility to the user is the transportation charge.

Advancements in Printing Press Design. Miehle Printing Press & Mfg. Co., 14th St. and S. Damen Ave., Chicago 8, Illinois. 23 min. b&w.

Curves of Color. General Electric Co., 1 River Road, Schenectady, N. Y. 10 min. color.

Serving the Graphic Arts. Sinclair & Valentine Co., Inc., New York, N.Y. 28 min. color.

The Offset Press. Harris-Seybold Co., 4510 E. 71st St., Cleveland 5, Ohio. 35 min. color.

Trees to Tribune. Modern Talking Picture Service, Inc., 142 E. Ontario St., Chicago 11, Illinois. 40 min. color.

Linoleum Block Printing. Bell and Howell, 1801 Larchmont Ave., Chicago 13, Illinois. (rent $.50).

GRAPHIC ARTS II INTRODUCTION

In Graphic Arts II, the students will be given opportunities to apply the experiences, skills, and knowledge acquired in Graphic Arts I to more advanced projects. Instruction is designed to develop a better understanding of the basic principles of design, the need for orderly planning, good judgment in the selection and use of type, borders and ornaments, acquiring skill in machine composition and advanced presswork. Special emphasis is given to proofreading and the development of proper techniques for making corrections in type forms.

Quality in graphic arts instruction requires a variety of methods. It necessitates basic fundamentals, as well as original ideas in such methods and techniques as, class discussion, shop talks, individual instruction, resource speakers, and plant visits.

The most effective method depends upon the planning of the teacher and the interests, abilities, and personalities of each student. The teacher will employ the method or methods that will best serve the varying needs of the students.

UNIT I: ORIENTATION

UNDERSTANDINGS

The student should:

- acquire a clear understanding of the nature and purpose of Graphic Arts II
- perform hand processes with special emphasis on advanced procedures
- recognize need for acquiring skill in detecting typographical errors.

OUTLINE OF CONTENT

A. Areas of instruction
   1. Advanced hand composition
   2. Elementary machine composition
   3. Proofreading
   4. Advance presswork
   5. Opportunities in the graphic arts industry

B. Advanced hand composition
   1. Setting more complicated projects
      a. Design and layout
      b. Small business and social forms
   2. Correcting errors in form

C. Proofreading
   1. Practice
      a. Marking system
      b. Styles
   2. Use of dictionary and other sources of reference
   3. Some common and frequent errors
   4. Occupational requirements material

SUGGESTED LEARNING EXPERIENCES

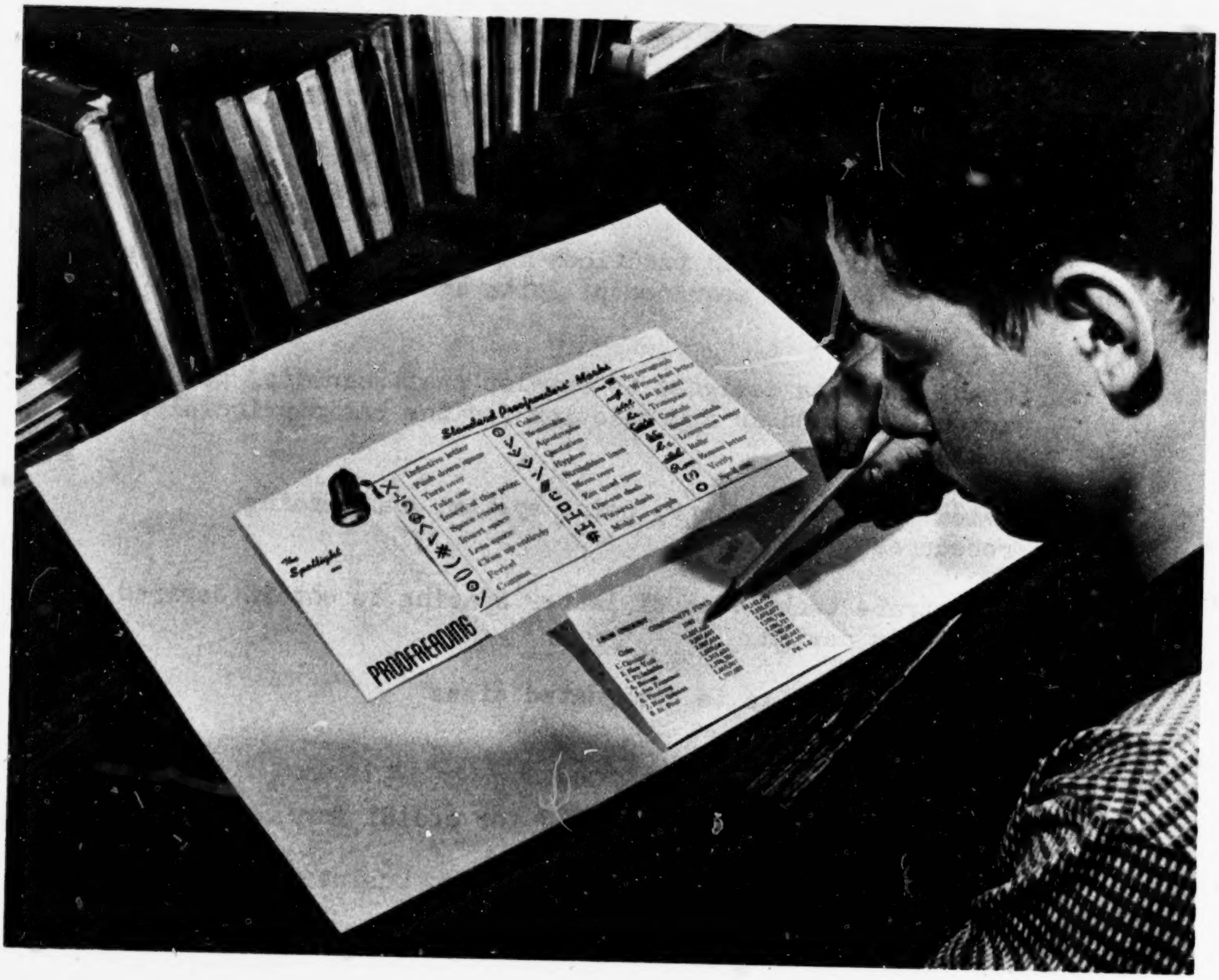
The words "composition" or typesetting" as used in printing describe the process of setting and arranging type. There are several ways of setting type. Machine composition came into use in the latter part of the 19th century with the invention of the Linotype and Ludlow machines. The latest development is photo-composition. In modern typesetting, combinations of machine composition with display headings set by hand are often used.

Advanced Hand Composition

Local problems, conditions, or practices may necessitate variations in the scope, emphasis, or sequence of units and materials listed here:

1. Prsent projects designed to develop craftsmanship, good work habits, and an appreciation for the basic principles of design
2. Review type terminology, point system, and spacing procedures
3. Demonstrate techniques of letter spacing to obtain desired effects in design
4. Cut strip material to designated sizes
5. Use composing room saw
6. Make a study of type faces used for social forms
7. Make layouts for and set up social and business forms
8. Promote safety "conscientiousness" for all facets of school activities.

(References: 3, 4, 5, 8, 12, 15).


Standard Proofreaders' Marks
PROOFREADING

Proofreading - the Act or Business of Reading and Correcting Printers' Proofs

ORIENTATION

Proofreading

Proofreading is primarily the art and practice of finding mistakes in printed forms before the job is printed. All errors are indicated by the proper proofreader's marks.

1. Provide galley proofs for student practice in reading and marking proofs
2. Give blackboard demonstration in marking proofs
3. Cite some common and frequent errors
4. Have students use dictionary and other available reference.

UNIT II: SUPPLEMENTARY COMPOSING ROOM EQUIPMENT

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Operation of metal saw
learn to operate a metal saw	1. Safety precautions
acquire techniques of proofing and correcting type forms.	2. Capabilities of saw
	3. Adjustments
	4. Straight cuts on metal and wood
	5. Cutting of leads and slugs
	B. Operation of Miterer
	1. Safety precautions
	2. Hand Miterer
	3. Power Miterer
	5. Practice in use of machines
	C. Proofing and correcting of machine composition
	1. Dumping stick
	2. Pulling galley proofs
	3. Making galley correction
	4. Reading revised proof
	5. Pulling final proof

SUGGESTED LEARNING EXPERIENCES

The ability to pull good proofs is an important and valuable qualification and can not be considered as a mere mechanical operation.

A good proof is an example of skill; clearn and sharp proofs make proofreading easier and show up minor defects in the type form:

1. Suit ink to the proof paper
2. Allow liberal margins on each proof sheet
3. Indicate correct margins on proof sheet
4. Keep proof presses clean
5. Wash type thoroughly
6. Observe all safety precautions.

(References: 7, 9, 14).

UNIT III: BEGINNING MACHINE COMPOSITION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Development of machines
learn about the three basic line casting machines	1. History and progress
	2. Significance of development
be able to coordinate finger dexerity and ability to read and interpret copy	3. Body and display models
	4. Mixer models
realize value of good spelling and word division habits.	B. Line casting machines
	1. Linotype
	2. Intertype
	3. Ludlow
	C. Duties and responsibilities of operator
	1. Specific skills and techniques
	2. Operating keyboard
	3. Mechanics of setting and casting a line of type
	D. The teletypesetter
	1. How it functions
	2. How and where used

SUGGESTED LEARNING EXPERIENCES

Elementary Machine Composition

Units II and III should present a general outline of instruction for elementary machine composition, its main problems and advantages. They should also include a general exposition of the Monotype and Ludlow machines as well as the Elrod and Monotype strip material makers.

Provide instructional material, charts, demonstrations, and teacher-student discussions to familiarize students with the following phases of machine operation and machine composition

1. Matrix assembling mechanism
2. Casting mechanism
3. Distributing mechanism
4. Safety devices and precaution.

Acquaint students with daily care of machines, spacebands, matrices, lubrication, mold and disk, metal pot and plunger.

Provide dummy for student to learn keyboard arrangement and finger exercises.

Have students set word and sentence exercises to develop proper fingering system and a rhythmical operating speed, spacing out and justifying lines.

Set straight matter to acquire speed and accuracy in reading copy and operating keyboard.

1. Set up copy involving capitals and small capitals
2. Set up italics and bold face type
3. Set copy containing leaders
4. Set mixed lines.

Learn functions of duplex rails.

Set up newspaper copy: small adveristement and small programs.

Discuss problems to be encountered in machine composition.

TEACHER'S NOTES

BEGINNING MACHINE COMPOSITION

Have students compile a list of machine composition terms.

Provide samples of printing produced by the photographic or "cold type process".

Review safety regulations.

(References: 8, 10, 11, 12).

Setting Straight Matter Composition

The teacher should have the students:

- Prepare machine to set 8 point type on 10 point slug, 12½ picas wide
- Use an em quad for paragraph indention
- Place a space band between words
- Divide words at syllables only
- Place thin space between words in addition to spacebands when line cannot be properly filled with copy
- Get teacher's o.k. on the first line before he sends it into the machine

Set this copy according to above directions.

COPY

Beginning operators have a tendency to sacrifice accuracy and correct typography for the sake of speed. This tendency cannot be criticized too harshly. Bad habits are difficult to break, so take the additional time necessary to do a good job.

Besides the many other objectionable features of poor typography, errors are costly. It takes the time of three men to correct them - the proofreader, the operator, and the one who makes the galley corrections. Therefore, this should be the guide, 'speed after accuracy.'

(References: 8, 10, 11).

UNIT IV: MONOTYPE AND ELROD MACHINES

UNDERSTANDINGS

The student should:

recall the chief differences between the monotype machine and the linotype machine.

OUTLINE OF CONTENT

A. The monotype machine
  1. Its function and use
    a. Keyboard
    b. Caster
  2. The keyboard
    a. Monotype unit system
    b. Keyboard layout
    c. Ribbon
    d. Justification
    e. Tabular work
  3. The caster
    a. Justification mechanism
    b. Inserting ribbon
    c. Type galley
  4. Various monotype models
B. Strip material makers
  1. Kinds
    a. Elrod
    b. Monotype
    c. Universal
  2. Function and principle
    a. Mold
    b. Casting mechanism
    c. Operation
    d. Products

SUGGESTED LEARNING EXPERIENCES

The Monotype Machine

The process utilizes two units, the keyboard and the casting machine. First, the operator seated at the keyboard presses the keys. This perforates holes in a paper tape. Each character is represented by a different set of perforations. Next, the tape is run through the casting machine which molds each letter singly and rapidly.

Provide wall charts depicting principal working parts.

Make reading assignments.

Make plant visits in order that students may see this equipment in operation.

Discuss the machine and the process with the students.

(References: 8).

UNIT V: THE LUDLOW MACHINE

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. The Ludlow machine
be made aware of the uses and limitations of the Ludlow machine	1. Functions and use a. Slug casting system b. Ludlow rule form system
compare the composition of the various metals used in the different machines	2. Ludlow composition a. Matrix case b. Ludlow Roman composing stick c. Ludlow Italic composing stick d. Ludlow justification e. Ludlow quadding
	3. Ludlow slug casting a. Inserting the stick b. Repeat casting c. Overhanging slug
	4. Ludlow rule form system a. Rule slug b. Type headings c. Rule form slugs
	B. Metal 1. Linotype metal 2. Monotype metal 3. Foundry metal

SUGGESTED LEARNING EXPERIENCES

Ludlow Machine

The Ludlow system is a combination of hand and machine composition. The individual matrices are set by hand from a case resembling a type case. A special composing stick is used and the matrices are set up in lines the same as hand set type. Each line is then inserted into the Ludlow casting device and makes a complete slug from the line of matrices. The advantage of this system is that each line of type is new.

1. Discuss the role of Ludlow composition in the commercial and newspaper plants.
2. List helpful reference material.
3. Compare operating principle and the product of the Ludlow with the linecasting machine.
4. Visit commercial plant in order that students may see Ludlow equipment in action.

(References: Ludlow Operators Manual, 8).

UNIT VI: TYPE METAL

UNDERSTANDINGS

The student should:

develop a general understanding of the physical and chemical characteristics of type metal.

OUTLINE OF CONTENT

A. Type metals
  1. Type-casting machine metal
    a. Lead
    b. Antimony
    c. Tin
  2. Physical and chemical properties
    a. Provision for sharp castings
    b. Necessity of withstanding wear and pressure
    c. Need for short period for solidification
    d. Avoidance of drossing excessively during melting

B. Function of three elements
  1. Lead
    a. Base metal
    b. Mixes readily with other alloy
  2. Antimony
    a. Gives hardness and fluidity to lead
    b. Expands upon solidification
  3. Tin
    a. Gives body to metal and adds to its toughness
    b. Gives type smooth face

SUGGESTED LEARNING EXPERIENCES

Related Technical Information

Type is made of comparatively soft metal and should be handled with care. To avoid damage, never lay any metal object on the face of a form of type. Lead alone is too soft for type, so other metals are added. Tin gives body and toughness. Antimony is an important metal used in casting type and makes the letter clear, sharp, and well defined. Copper is added to foundry type to increase its durability.

Avoid mixing different type metals.

Composition of linotype metal. This metal is an alloy of lead, tin, and antimony. The lead is used to give body to the mixture because of its low melting point. The tin makes the metal tough, serves to unite the other two metals, and causes the mixture to flow quickly and cast sharply. Antimony is used to make the mixture hard in order to resist wear.

Metal made from virgin metals will give better results and not deteriorate as rapidly as that made from reclaimed metals.

acquire the technical knowledge needed to produce perfect slugs.

C. Line slug metal

1. General properties of metal
    - a. Suitability to particular mechanisms of different machines
    - b. Uniformity
    - c. Free from impurities

2. Impurities and their influence in type metal
    - a. Dross
    - b. Chemical analysis
    - c. Rebuilt to proper proportions

TYPE METAL

Students should learn the composition of type and slug metals, their melting temperatures, and reasons for not mixing them.

Compare the merits of wood and metal type in different sizes.

Have students discuss:

1. Safety precautions
2. Care of metal
3. Common metal troubles.

(References: 8, Manufacturer's Manual, "Type Metal").

UNIT VII: EQUIPMENT FOR "COLD TYPE" COMPOSITION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Field of non-metal composition
review the methods of and need for photo composition.	1. The photosetter
	2. Typewriter composition
	3. The photon
	4. The linofilm
	B. Application to commercial printing, book work, and newspaper composition
	C. Various machines for typewriter composition
	1. The IBM
	2. The Varityper
	3. The Justowriter
	4. The Fairchild Lithotype
	D. Paste-up of non-metallic composition
	1. Hand composition of paper or plastic type
	2. Assembly
	3. Retouching
	4. Color overlays

SUGGESTED LEARNING EXPERIENCES

The widespread use of photography in the graphic arts industry is responsible for the development of typesetting machines to produce photographic composition on a commercial basis.

The photographic typesetter is an automatic composing machine. It produces justified copy in strip form directly on film or photographic paper. In this machine the metal melting pot and mold are replaced with a photographic unit. The camera operates on the letter-by-letter principal of photographing each letter individually.

Photo-composition is used for offset, gravure, and letterpress printing, and standard platemaking methods are used in each one.

Provide illustrated material for students to study.

Make reading assignments.

Utilize community industrial resources.

Show film provided by the Intertype Company.

(References: 8).

UNIT VIII: LETTERPRESS PLATE MAKING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Zinc etchings
learn the history and development of letterpress plate making	B. Halftone process
	C. Ben Day
study the imporatance of the plate making industry in modern day printing.	D. Four-color process
	E. Electrotype
	F. Stereotypes
	G. Rubber plates

SUGGESTED LEARNING EXPERIENCES

Have the students study and discuss photoengraving.

1. Discuss the history and development of plate making.
2. Show importance of plate making to modern day printing.

Discuss with the students the various methods of making different kinds of plates. Have samples so students can recognize and tell the need and differences of the various kinds and types of plates.

Gather and display samples of printed materials produced from various types of printing plates.

(References: 2, 6, 14).

UNIT IX: PRESS PREPARATION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should: learn to operate and care for press while running job be cognizant of the various makeready techniques employed and the need for alertness in controlling quality of printed product.	A. Feeder unit 1. Safe position of feeder 2. Preparation of stock 3. Loading feeder 4. Removing printed sheets 5. Running press 6. Safety precautions B. Makeready techniques 1. Position of press 2. Changing packing 3. Form lockup 4. Setting gauge pins 5. Setting side register guide 6. Setting feeder arm 7. Setting delivery 8. Checking ink and impression 9. Checking settings and adjustments with manual

SUGGESTED LEARNING EXPERIENCES

Basic technical information is needed for advanced presswork.

Cite importance of presswork in the production of a job of printing.

Acquaint student with the major improvements in some of the pressroom operations.

List essential equipment, materials, and tools required for presswork.

Discuss with students:

1. Duties of a pressman
2. Need for exercising care
3. Importance of mechanical ability
4. Need for pressman to know about ink, paper, rollers, type and plates.

Display good samples of presswork.

(References: 7, 14, 15).

UNIT X: THE AUTOMATIC PRESS

UNDERSTANDINGS

The student should:

acquire the knowledge and skill needed to operate automatic presses

study and compare hand fed presses with automatic presses

review safety regulations and the need for student cooperation at all times.

OUTLINE OF CONTENT

A. The automatic press
    1. Principal parts
        a. The printing unit
        b. The inking unit
        c. The feeder unit
        d. The delivery unit
        e. Safety precautions

B. The Kluge automatic
    1. General information
        a. Sheet size
        b. Form size
        c. Dead line
        d. Packing
    2. Press mechanism
        a. Structure of press
            (1) impression mechanism
            (2) inking mechanism
            (3) feeding and delivery units
            (4) electrical equipment
            (5) air blast and vacuum
    3. Safety precautions
    4. Pressroom terminology

SUGGESTED LEARNING EXPERIENCES

Advanced Presswork

Provide presswork projects that will familiarize student with the following:

1. Mechanical principles of automatic presses
2. Functions of their main parts
3. Working knowledge of inks and their relationship to different kinds of paper
4. Mixing colors
5. Steps in makeready
6. Operation and care for a machine in performance of work within its range.

Review all safety rules and precautions plus the new safety rules applicable to each unit of automatic equipment.

Discuss advantages and disadvantages of printing jobs on different presses.

Review sequence of steps in makeready, underlaying, overlaying, and makeready of forms with machine and handset composition.

Provide projects in halftone makeready, underlaying, interlaying, and overlaying of wood mounted cuts.

(References: 5, 8, 14).

UNIT XI: OPERATION OF THE VERTICAL PRESS

UNDERSTANDINGS

The student should:

- learn names and functions of principal working parts of press
- list advantages and disadvantages of vertical cylinder press compared to a platen press
- learn to put form on press, makeready, and run job.

OUTLINE OF CONTENT

A. Principal working parts
    1. Printing unit
    2. Automatic feeder and delivery unit
    3. Inking unit
    4. Electrical controls

B. Press specifications
    1. Maximum sheet size
    2. Minimum sheet size
    3. Maximum form size
    4. Amount of packing
    5. Speed of press

C. Position of form
    1. Chase jacks
    2. Chase marks and clamp
    3. Setting or changing side guides

D. Rollers and ink fountain
    1. Setting and locking
    2. Removing rollers

SUGGESTED LEARNING EXPERIENCES

Review general safety rules plus specific safety rules applicable to the vertical press.

Provide presswork projects to familiarize student with the mechanics of this press.

Discuss advantages and disadvantages of printing jobs on this press.

Review steps in putting a job on this press and warn students of the "deadline."

UNIT XII: CYLINDER PRESSES, VARIATIONS AND MODERN TECHNIQUES

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	
learn the names, sizes and functions of various cylinder presses	A. Flat-bed cylinders (handfed) 1. Sheet sizes 2. Form sizes 3. Speed of presses
understand uses and advantages of one cylinder press over another	B. Automatic cylinders 1. Sheet sizes 2. Form sizes 3. Speed of presses
learn principles of rotary presses	C. Rotary presses
learn principles of web presses	D. Web presses 1. Perfecting 2. Offset 3. Letterpress
study fundamentals of dry offset method of printing	E. Dry offset method 1. Advantages 2. Combination with letterpress
describe functions of electrostatic method of printing.	F. Electrostatic method 1. Principles 2. Advantages

CYLINDER PRESSES, VARIATIONS AND MODERN TECHNIQUES

Discuss the various sizes of flat-bed cylinder presses (handfed) and point out the purpose and best use for this type of equipment.

Compare the various sizes of automatic cylinder press and the purpose best suited for this kind of equipment.

Have students submit reports and technical information on the rotary presses, web presses, dry offset and electrostatic methods of printing.

(References: 7, 14).

UNIT XIII: BASIC OPERATIONS IN OFFSET PRINTING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. The offset printing industry
become acquainted with the basic theory of offset printing	1. Introduction to process
	a. Basic principle
	b. Advantages
acquire an understanding of the skills and knowledge needed to perform lithographic operations.	c. Development of process
	d. Importance of this process in the industry
	2. The main steps in lithography
	a. Art and copy preparation
	b. Camera work
	c. Litho art
	d. Stripping
	e. Proving
	f. Plate making
	g. Presswork
	B. Copy preparations
	1. Methods of type composition
	a. Wood type and metal type
	b. Hand lettering
	c. Typewritten type
	d. Photographic page-composed type
	e. Photographic strip type

SUGGESTED LEARNING EXPERIENCES

Offset Printing

The mutual repellancy of grease and water is the principle of lithography. Until the beginning of the 20th century, lithography was used mainly for quality color work and quality reproduction of illustrations. In the early part of the 20th century, the offset press was added to lithographic production.

In actual practice offset printing is an impression from a planographic plate made upon a flexible rubber surface and from that surface transferred to paper or other material.

The development of faster single and multicolor offset presses, the refinements of films, the chemistry of photography, the perfecting of photo mechanical equipment, and the improvement of inks, paper, rollers, and chemical processes have raised offset to its present important and necessary place in the graphic arts industry.

Obtain descriptive material from the manufacturers of equipment and supplies used in offset printing.

Utilize resources of community printing plants and the various trade associations.

Display and discuss descriptive material.

Make reading assignment.

Show films depicting offset process.

Visit printing plants where students may observe the various offset operations.

Investigate and study capabilities of office duplicating equipment.

(References: Bibliography I, 5, 12, 14).

UNIT XIV: THE MAIN STEPS IN LITHOGRAPHY

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should: acquire an understanding of the skills and knowledge needed to perform basic lithographic operations study and compare the major printing processes with the offset method.	A. Camera work 1. Operations a. Line photography b. Halftone photography c. Continuous tone photography d. Color separations e. Masking f. Step and repeat on small units B. Litho art 1. Making of corrections a. Opaquing b. Correcting of tone by dot etching and retouching c. Correcting of color by dot etching and retouching d. Correcting of damaged plates e. Translating creative art into producible art

SUGGESTED LEARNING EXPERIENCES

Camera Work

Since offset is a photographic process, it is essentially true that anything that can be photographed can be reproduced by offset. Camera work is a very interesting part of lithography. Although it varies in some respects, it is very similar to camera work employed in a photoengraving plant.

Teacher Student Discussions

Discuss with the students:

1. Reproduction of type matter
   - a. Hand or machine set
   - b. Typewriter composition
   - c. Hand lettering
2. Production of facsimile
   - a. Reprints from printed material
   - b. Letterheads
   - c. Letters
   - d. Charts or graphs
   - e. Blueprints
3. Line drawings and illustrations
   - a. Pen and ink drawings
   - b. Crayon
   - c. Ben days
   - d. Hand ruled forms
4. Halftone reproductions
   - a. Tone values
   - b. Halftone screens
   - c. Halftone negatives
5. Printing of color
   - a. Flat colors
   - b. Ben Day
   - c. Color process
   - d. Direct color photography

Brandtjen-Kluge Printing Press,
a Platen Press with Automatic Feeding Unit

THE MAIN STEPS IN LITHOGRAPHY

6. Photo-lithographic camera
   - a. Types of offset cameras
   - b. Importance of lens to camera
   - c. Copyboard and its use
   - d. Organization of dark room

UNIT XV: PREPARATION OF OFFSET PRINTING PLATES

UNDERSTANDINGS

e student should:

acquire an understanding of the skills and knowledge needed to perform basic lithographic operations

compare various plates and their suitability for different jobs.

OUTLINE OF CONTENT

A. Stripping
  1. Operations
    a. Laying out and stripping the flat
    b. Equipment, tools, and supplies
    c. Preparation for stripping
    d. Supplementing camera work
    e. Special techniques and effects
    f. Laying of prints and opaquing

B. Platemaking
  1. Types of plates
    a. Zinc
    b. Aluminum
    c. Tri-metal
    d. Paper
    e. Plastic

C. Presswork
  1. Kinds of presses
  2. Offset ink
  3. Offset rollers
  4. Chemistry of presswork
  5. Offset paper
    a. Suitability
    b. Kinds and sizes
    c. Paper troubles

PREPARATION OF OFFSET PRINTING PLATES

SUGGESTED LEARNING EXPERIENCES

The photo-lithographic stripper is to the offset process what the lockup and make up man is to letter press. Both work from a dummy or layout. The make up man in letterpress arranges type pages or cuts while the stripper in the offset process arranges positives or negatives of film on a layout commonly known in the trade as a flat.

The student should list the tools, equipment and supplies used in the stripping operation:

1. Types of paper used to impose negatives to float
2. Checking for correct position
3. Stripping line negatives
4. Cutting in marks on flat for platenmaker
5. Measuring for position and lining up
6. Stripping in halftones.

Only metal plates are used on the larger offset presses. Smaller presses, such as the multilith or Davidson, use photographically prepared metal plates. In addition to these, the smaller presses also use paper direct image plates. You can type or draw directly on the paper plates. Presensitized plastic plates will take a photographic image.

Discuss the operations involved in producing a plate:

1. Cleaning plate
2. Coating plate
3. Printing plate
4. Inking plate
5. Developing plate.

Give student reading assignments.

List equipment and material used in platemaking.

UNIT XVI: OFFSET PRINTING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Operation of offset press
strive for quality production at all times	1. Supervision to maintain quality of printed job
	a. Register b. Color c. Cleanliness d. Picking and splitting of paper e. Common ink and paper trouble
	2. Operating divisions
	B. Multilith offset
	1. Capacity of machine
	a. Maximum 11" x 14" b. Minimum 3" x 5" c. Duplicating area maximum 9½" x 13"
	2. Operating divisions

SUGGESTED LEARNING EXPERIENCES

The offset press operates on the rotary principle and prints at each revolution. The main operating divisions of the offset press include the following units:

1. Feeding mechanism
    - a. Automatic feed
    - b. Efficient handling of stock
    - c. Variety of paper
2. Printing unit
    - a. Three cylinders, plate, blanket, and impression
    - b. Function of blanket cylinder and rubber blanket
    - c. Basic differences between offset operations and other press operations
    - d. Types of plates used in offset printing
3. Inking mechanism
    - a. Inking unit
    - b. Dampening system
    - c. Care of rollers
4. Chemistry of presswork
    - a. Fountain solutions
    - b. Chemical effects of paper and ink
    - c. Papers for offset printing
5. Other offset presses
    - a. ATF
    - b. Davidson
    - c. A B Dick
    - d. Harris
    - e. Miehle.

UNIT XVII: BINDERY OPERATIONS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Paper sample cabinet and price list
review standard sizes and weights of paper	1. Comparison of papers
estimate paper requirements and cut it to given size	2. Comparison of prices 3. Direction of grain
be aware of all safety rules and regulations applying to power paper cutter	4. Right and wrong side B. Cutting of paper
be made to realize the need for accuracy in operating paper drill	1. Procedure for cutting paper 2. Handling paper 3. Counting and jogging 4. Accuracy and neatness
	C. Power paper cutter 1. Review of safety regulations 2. Setting gauge and clamp 3. Stacking lifts of paper
	D. Setting up of and operating of the power paper drill

SUGGESTED LEARNING EXPERIENCES

Point out and discuss various kinds, finishes, sizes, weight, and colors of paper and card stock.

Indicate the problems that may be encountered in the various finishes of stock, type of form you may be printing from, and problem of ink colors on different shades and types of stock.

Indicate a variety of ways of buying paper economically:

1. Full package orders
2. Combination orders
3. Price breaking points
4. Close out and odd lot purchase.

Check various paper sizes available, always double check the possibility of a "dutch cut." Always be sure the grain is running the "right" way.

To solve paper problems have students apply the basic skills and technical information acquired in Graphic Arts I.

survey binding problems and cite the best solutions

compare hand folding work with the automation involved in the automatic folding machine.

E. Variety of bindings
    1. Simple single fold
    2. Case-hardened covers
    3. Saddle and side stitch
    4. Plastic binding
    5. Spiral wire
    6. Perfect bindings
    7. Case covers

G. Automatic folding machines
    1. Simple fold - 4 pages
    2. Parallel fold - 6 pages

BINDERY OPERATIONS

Show samples of all types of binding to the students, and explain the various bindings which fit into the variety of jobs.

Stress the importance of good bindery operations. Illustrate the variations in costs of the different types of binding and explain that cost may dictate the type of binding used for a job.

Many types of automatic folding machines are in general use today. Some are adapted to fold large book signatures, others are devised for all styles of job folding. Most folding machines may be equipped with automatic feeds and deliveries, similar to those on presses.

The knife folder is generally used for straight publication work since it is faster and more accurate for folding larger sheets. It can fold 64 pages in one continuous operation.

However, the roller operated folders are more versatile than the knife folders, and are therefore, better suited for all types of printed material.

Have students make a survey of bindery equipment:

1. Folding machines
2. Cutters
3. Sewing equipment
4. Wire stitches.

(References: Bibliography I, 4, 8).

UNIT XVIII: PRINTING INKS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. History of inks
learn about the kinds of ink	B. Kinds of ink
develop an understanding of the importantance of printing ink	C. Importance of ink D. Manufacturing process
learn about the ingredients used in the manufacture of printers ink.	1. Ingredients 2. Terms used to describe ingredients of ink
	E. Qualities of ideal ink
	F. Packaging of ink

SUGGESTED LEARNING EXPERIENCES

The student should understand the working qualities of the various kinds of ink.

Discuss with the students:

1. Necessary qualities of good ink
2. Working properties of printing ink
3. Difference between drying and setting
4. Reducers and driers
5. Ingredients of ink
6. Effect of temperature on printers ink.

Have the students list the things that are important to know about printers ink.

Discuss some of the common ink problems.

UNIT XIX: MIXING AND MATCHING OF COLORS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Basic principles of color combinations
become acquainted with commonly used color combinations	1. Color harmony
learn proper procedure for mixing ink.	2. Contrasting colors
	3. Warm colors
	4. Cold colors
	5. Transparent ink
	6. Opaque
	7. Ink and paper relationship
	B. Procedures for mixing and matching colors
	1. Primary color
	2. Secondary color
	3. Tertiary color
	4. Tints
	5. Color chart
	6. Formulas
	7. Techniques for mixing colors

MIXING AND MATCHING OF COLORS

SUGGESTED LEARNING EXPERIENCES

Teach how to mix colored ink:

1. Acquaint student with some commonly used color combinations
    - a. Importance of selecting color and grade of ink that will conform to color and grade of paper
    - b. Demonstrate proper procedure for mixing ink
    - c. Study color charts to learn various combinations
    - d. List six color combinations of colored ink and colored paper to illustrate
        - (1) Color harmony
        - (2) Contrasting colors
2. Discuss with the students:
    - a. Primary colors
    - b. Secondary colors
    - c. Tertiary colors
    - d. Tints
    - e. Color harmony
    - f. Contrasting colors
    - g. Warm colors
    - h. Cold colors
3. Explain the need for opaque and transparent ink
4. Mix ink to match sample

Present related technical information:

1. Explain that one may always add more dark ink, but it may take pounds and pounds of the lighter ink to lighten ink that has been made too dark.
2. Acquaint the students with the following information:

Olive - white, yellow, blue, and touch of black
Maroon - red and black
Dove - white, red, and touch of blue
Drab gray - white and touch of black
Brown - yellow, red, and black
Chocolate - white, red, and black
Buff - white, yellow, red, and touch of black
Green - yellow and blue
Orange - yellow and red
Purple - red and blue
Lemon - chrome, yellow and white
Cream - yellow and white

The Students of a Printing Class Discussing Inks Used on a Four-color Job

MIXING AND MATCHING COLORS

Flesh - yellow, white, touch of red
Gray - white, yellow, touch of black
Lilac - red, white, touch of blue
Pearl - white, blue, yellow, touch of black
Pink - white and touch of red
Rose - white, yellow, and touch of red
Snuff - yellow and bismarck brown
Violet - red, blue, and white

(References: 1, 3, 5, 13, 14).

UNIT XX: BASIC PRINCIPLES OF DESIGN

UNDERSTANDINGS

The student should:

cite and list carry-over knowledge from previous art study

apply previous study and art knowledge.

OUTLINE OF CONTENT

A. Layout and design - study of the basic principles

1. Balance
    - a. Mass, shape
    - b. Shape
    - c. Color
    - d. Geometric pattern
2. Proportion
    - a. Areas
    - b. Panels
    - c. Color
3. Harmony
    - a. Shape
    - b. Tone
    - c. Color
    - d. Fitness to purpose
4. Contrast
    - a. Color
    - b. Shape
    - c. Position
5. Fitness
    - a. Balance and harmony of color
    - b. Shape
    - c. Size and purpose

B. Correct use of white space and grouping

C. Rough layouts and thumb nail sketches

SUGGESTED LEARNING EXPERIENCES

One should learn the various principles involved in making good layouts.

We should learn the application of all of these principles in relation to good printing, good layouts and harmony in selection of types, colors, sizes and design.

The principle of proportion should leave us with the following formulas in mind:

2 to 3 3 to 5 5 to 8

Good printing consists not so much the choice and arrangement of type but of the arrangement of the spacing.

Make thumb nail sketches - fast and easy - follow with rough. It is far cheaper working this method than setting and resetting type. Promote value of layout in printing. Can't operate without a plan - printing requires the same principles as good engineering practices.

(References: 3, 4, 9, 14, 16).

Opportunities in the Graphic Arts Field

The graphic arts industry is made up of many diversified groups. In addition to the major segments of the industry, we include the manufacturing of printing presses, bindery and allied equipment, printing inks, paper, ink rollers, chemicals, and other supplies used primarily by the graphic arts industry.

The continued growth of the industry due to new technological developments, new processes, new materials, and new equipment has emphasized the need for well-educated and well-trained professional managers, scientists, engineers, and printing teachers.

Graphic arts education divides into following groups:

1. Exploratory
2. Vocational
3. Professional.

Exploratory courses:

1. Industrial arts courses in upper grade centers
2. Industrial arts courses in senior high schools.

Vocational graphic arts courses

1. Vocational courses in high schools
2. Vocational high school courses
3. Evening school courses
4. Apprentice training courses.

Professional printing education

1. College education for printing management, sales, technical writing, and advertising
2. College education for teaching graphic arts instruction
3. Graphic arts as part of college education for the fine and applied arts.

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Inland and American Printer and Lithographer. Chicago: McLean-Hunter Publication.

Printing Magazine. Oradell: Walden Sons and Mott.

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FILMS

All films listed below are available gratis on request. In most cases the only responsibility to the user is the transportation charge.

Voice of Business. Hammermill Paper Co., Erie, Pa.

Magazine Magic. Modern Talking Picture Service, Inc., 142 E. Ontario Street, Chicago 11, Illinois. 27 min. color.

Book of Books. Bell and Howell, 1801 Larchmont Avenue, Chicago 13, Illinois.

Cavalcade of Color. Eastman Kodak Company, Camera Club and School Service, 343 State Street, Rochester 4, N. Y. color.

Making the Funnies. Bell and Howell, 1801 Larchmont Avenue, Chicago 13, Illinois. (rent $1.50).

Keeping in Touch. International Printing Ink Corporation, Chicago, Illinois.

Timber is a Crop. National Publishers Assn., 232 Madison Ave., New York, N. Y.

Making Books. Encyclopedia Britannica Films, Inc., 20 N. Wacker Dr., Chicago, Illinois.

WOODWORKING INTRODUCTION

Woodworking gives the student basic tool processes, skills, and knowledge of the woodworking industries that will be of great importance to him as a consumer. Many of the tool processes, technical terms, and information will be of value to him should he later pursue woodworking as a vocation.

There are many challenging projects, exercises, and experiments afforded the student in the woodshop which require skill in the use of tools and machines. Students are not only able to progress as fast as their capabilities permit, but they also have opportunities to develop designs for their projects.

Arithmetic is often used in woodworking. Examples include the measuring of lumber sizes, the determination of board feet required for a job, the computation of the cost of the lumber, figuring square feet of plywood and wallboard, use of the framing square in laying out stock, use of dividers in making circles and arcs, dividing a board into an equal number of widths, and the squaring of a piece of stock.

Student project work should start early in the semester before all of the introductory lecture work is finished. Woodworking is a shop course where students should devote at least 70% of their time in making well designed useful projects.

The bibliography included at the end of each semester's work is extensive, and includes textbooks, reference books, moving pictures, and slide films. Each of these references has been carefully evaluated and they contain information or project designs of proven value.

UNIT I: ORIENTATION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Orientation of students
be introduced to the shop, machinery, and location of tools	1. Welcome 2. Tour of shop
be taught the requirements of the shop and safety rules	B. Requirements of students 1. Knowledge of shop rules
provide a shop apron, note book, and necessary shop fees	2. Return of signed parents' permission blank 3. Knowledge of safety rules
develop a knowledge of the systems used in checking attendance, tools, and materials	4. Shop apron 5. Note book 6. Shop fees
use his assigned bench and recognize the shop foreman	C. Organization of personnel 1. Assignment of student bench 2. Checking of attendance 3. Checking of tools by students 4. Checking of materials by students 5. Role of student foremen

ORIENTATION

SUGGESTED LEARNING EXPERIENCES

During the first few meetings of a new class, make the students feel as if they would like to work in the shop. A tour of the shop describing briefly each power machine, location of tools, supplies, and lumber should be made; interest the students in the equipment and in how to use it.

Give a general overview of the course showing some of the jobs and projects the students will be expected to do during the semester.

Obtain a little knowledge of the youngster's experience with tools through informal conversation, quizzes, or information blanks.

State the rules of the shop clearly and post them on the bulletin board.

Distribute to each student "Parent' Permission Blank to Operate Power Machinery". These blanks are to be signed and returned and kept on file.

Discuss safety rules thoroughly and post them at strategic locations.

Expedite the assignment of benches and the making of seating plans and procedures for checking attendance, tools, and routine business.

Introduce student personnel organization now or as soon as students are known.

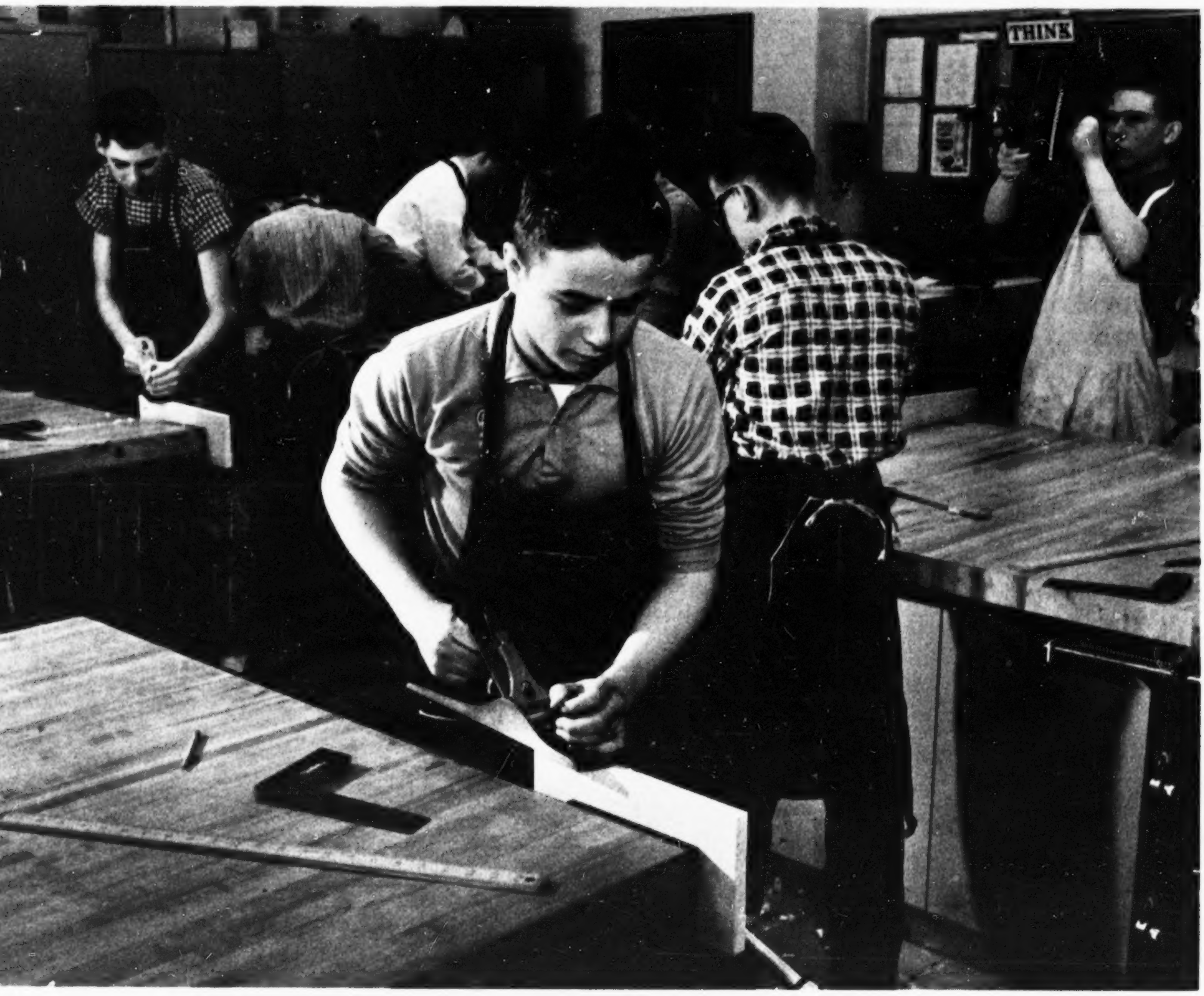
Require each student to have a shop apron.

Require each student to keep a notebook.

instructed in the require-
nts of the course, such as
ading assignments, notebook
rk, skills, and projects

D. Requirements of the course

1. Satisfactory completion of the required reading assignments
2. Attainment of necessary skills
3. Completion of required projects



The Jack Plane in Use

UNIT II: READING OF WORKING DRAWINGS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should: develop ability to read a ruler, the scale, and interpret simple working drawings for shop work.	A. Reading of simple working drawings B. Reading of the ruler C. Use of the scale D. Intrepretation of symbols

SUGGESTED LEARNING EXPERIENCES

Explain the term "scale drawing", show the relationship of the drawing to a finished project, and call attention to the difference in size of the drawing and the completed project.

Instruct the students in the conventions or symbols which draftsmen use when making drawings. These are well understood by workers who use these drawings. Most beginning textbooks on woodworking cover these essentials. (References: 4, 6, 7, 9, and 23).

UNIT III: HAND TOOLS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Measuring to fraction of an inch
develop an understanding of measured distances	B. Use of a rule or try-square
	C. Layout work
comprehend the shop rules, and accept responsibilities	D. Safety rules and guiding principles
	E. Practice of safe procedures
	F. Names of hand tools
	1. Ruler
	2. Try-square
	3. Jack plane
	4. Chisels
	5. Back saw
	6. Coping saw
	7. Cross cut saw
	8. Rip saw
	9. Hammer
	10. Mallet
	11. Brace
	12. Auger bits
	13. Hand drill
	14. Drill bits

SUGGESTED LEARNING EXPERIENCES

Use a large demonstration rule to present to the class, inches, half-inches, quarter-inches, eighth-inches, and sixteenth-inches. Have students locate 3/4", 3/8", 5/8", 5/16", 7/8", 13/16", and 15/16".

Demonstrate the use of the try-square by laying out a simple geometrical pattern, such as a rectangle on a board. A try-square is a measuring tool which is used for measuring and laying out lines at right angles.

(References: 4, 6, 7, 9, 12, 15, 23, and 24).

Post shop safety rules in a conspicuous place in the shop so that every student can see them.

Post rules for shop procedure or personnel duties.

Make sure every student is thoroughly familiar with these rules.

Many eye-catching safety posters are available from industry and the National Safety Council for display in the shop.

Have safety lines painted or marked off on the floor around each of the power machines, to designate a prohibited area except for the operator.

See safety and shop rules suggested in the following references: (6, 7, 9, 11, 15, 19, 20, 23, and 24).

As an overview of the course present the hand tools that are to be used.

Devise a test covering the work of this unit; this may be written or oral, or an electrical testing board may be used.

learn to use hand tools correctly

learn to care for tools

respect the cutting edges of cutting tools

learn to assemble a jack plane

develop the ability to grind and whet sharp-edged tools

understand why faces, edges, and ends of wood should be squared before attempting to use it in a piece of furniture

15. Countersink
16. Clamps
17. Files

G. Correct use of hand tools

H. Care and safe handling of sharp-edged tools

I. Assembling of a jack plane

J. Adjustments of a plane for various cuts

K. Grinding of sharp-edged tools

L. Use of the power grinder
    1. Tool properly cooled
    2. Grind square and to right bevel
    3. Wear goggles

M. Whetting of a sharp-edged tools

N. Truing up or squaring a piece of stock

Demonstrate each tool as to correct use, and exercise constant supervision of the pupils' use of these tools to make sure correct techniques are used.

(References: 6, 7, 9, 12, 15, 16, 24).

Demonstrate how poorly a dull plane cuts a shaving from a piece of wood then repeat the operation with a very sharp plane and point out how easily and effectively this cuts a shaving. Cutting edges must always be protected to keep them sharp. They should not be permitted to come in contact with any surface that will dull them except while in use.

Develop safety rules for handling sharp cutting tools.

Demonstrate the proper techniques of using the jack plane before permitting students to use this tool.

(References: 4, 6, 7, 12, 13, 23, 24).

Demonstrate how nicked cutting edges should be ground. Those without nicks should be whetted. Emphasize keeping blade cool with water or other coolants. Always wear goggles while using the grinder. Tools with cutting edges, such as chisels, plane blades, gouges, and spokeshave blades, become dull from use and require sharpening.

Show different oil stones or honing stones and how they are used to whet plane blades and chisels; also demonstrate the use of slip stones to whet inside curves of gouges. Continue whetting until cutting edges are sharp.

(References: 4, 6, 7, 9, 12, 15, 20, 23, 24).

Demonstrate why the squaring up of the material before final operations are started is basic to all woodworking.

Show correct procedures in squaring a piece of stock either by use of a film strip or by teacher demonstration.

Give each student a piece of stock for his beginning project (possibly a tie rack), and have him perform the squaring operation.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

develop skill in making layouts on material	O. Use of layout tools, including try square and marking gauge
	P. Making of a layout of a project on a piece of wood
develop some ability in use of the back saw	Q. Use of a back saw to cut to a line
	R. Use of a back saw to cut to specified depths
understand the various kinds of saws, their teeth, and how these teeth cut wood	S. Differences in saw teeth
	T. Use of the crosscut and the ripsaw
notice the narrowness of the saw blade used in the coping saw making possible cutting along curved lines	U. Use of the coping saw 1. Cutting inside curves 2. Cutting outside curves
	V. Adjustment of the coping saw 1. Turning blade for curves 2. Noting direction of teeth in frame
develop skill in using the claw hammer to drive nails and to withdraw nails	W. Use of the claw hammer for driving nails
	X. Use of the claw hammer for pulling nails

Show how the try square is used to make an edge at right angles or perpendicular to an edge. Also demonstrate how the marking gauge is set and used to make a line parallel to a finished edge.

Use try square and marking gauge to lay out ends and width of Project 1 (The tie rack, reference 6).

(References: 4, 6, 7, 9, 12, 15, 23, 24).

In squaring the stock for the first project, demonstrate the use of the back saw in cutting the ends of the stock. Students may improve their skill in using the back saw each time an end grain or short straight cut is made. (References: 4, 6, 9, 12, 15, 23, 24).

Use a large scale model of saw teeth of both crosscut and the ripsaw to develop the students' understanding of these differences.

Have the students perform the following tasks: use a crosscut saw to cut across the grain of wood; try to cut parallel to the grain with the crosscut. Use the rip with the grain of the wood and compare the differences. Try the ripsaw across the grain of the wood and notice the difficulty with which the saw operates.

Demonstrate or show a film that demonstrates the correct positions of holding saws and materials while cutting.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

Use the coping saw as the hand saw for cutting irregular lines. Demonstrate the proper use of the saw with teeth pointed one way (toward the handle). Then demonstrate the proper technique with the teeth pointed the other way. Be sure to explain fully under what conditions it is used one way and under what conditions it is used the other way.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

Demonstrate holding the claw hammer so that the correct amount of leverage is produced for the desired operation.

Arrange demonstrations on starting with a nail with the hammer, driving a common nail flush, driving a finish nail or brad to setting position, and using hammer and nail set to put nail in final position.

Show proper techniques of pulling nails with the claw, and the use of a block under the claw to pull along nails.

(References: 4, 6, 7, 9, 10, 12, 15, 23).

develop ability to distinguish correct sizes of auger bits and to use them skillfully	Y.	Designation of auger bits by size
	Z.	Use of auger bits with the brace
develop skill in the use of the hand and breast drill	AA.	Use of the hand drill
	BB.	Use of the breast drill
become skillful in using the countersink	CC.	Kinds of countersinks
	DD.	Use of countersinks
develop a reasonable degree of skill in the use of the screwdriver	EE.	Selection and use of the screwdriver
	FF.	Need to determine the depth of turning a wood screw
cultivate safe procedures in use of the chisel	GG.	Use of the wood chisel
	HH.	Safe use of the chisel
understand the correct procedure in laying out a piece of work	II.	Laying out of a job from a working drawing
develop an adeptness of checking a layout from a working drawing	JJ.	Checking layout of pieces of wood before cutting

HAND TOOLS

Arrange display of the several different kinds of wood bits that are available in the shop, including auger, dowel, forstner, power bits, and expansive bits. Describe and illustrate ways to tell the size of a bit. Use film strip, slides, or other visual aids to demonstrate the correct manner in which each of these bits is used. Emphasize that each type of bit is used for a specific operation. Distinguish between those used in a brace and those used in a power drill. (References: 4, 6, 7, 9, 12, 15, 23, 24).

Discuss appropriate circumstances for the use of the hand drill and the breast drill.

Display a chart showing drill sizes to be used when drilling holes for various size wood screws.

Select the proper size drill for a 1" - #8 flat head wood screw and demonstrate the correct use of the hand drill and drill point.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

Use a rose countersink and place in the brace, and countersink the hole just the right amount to receive the head of the screw.

Instruct students to select a screwdriver with a width of blade equal to the diameter of the head of the screw. Make sure the slot in the screw head is clear. Practice driving several screws to hold two pieces of wood.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

Demonstrate the use of the chisel to cut and fit a half-lap joint; also show how to use it in the making of a mortise and tenon joint.

Caution and instruct all students in the safe use of chisels, as they are sharp cutting tools and may cause serious injury.

(References: 4, 6, 7, 9, 12, 15, 23, 24).

Instructions covering the principles of good layout and design must be explained and demonstrated.

Check students' first layout carefully to be sure that they understand the principles involved.

(References: 4, 6, 7, 9, 23, 24).

understand use of each type of fastener

understand the use of clamps in gluing operation

develop some skill in making a joint, layout, and cutting operations

develop skill in layout, cutting, gluing operations

understand correct use of the file.

KK. Assembling of a project

LL. Use of glue and other fasteners in a final assembly

MM. Kinds of clamps

  1. C clamps
  2. Hand screw clamps
  3. Vises
  4. Bar clamps

NN. Use of clamps

OO. Doweled joint

  1. Locating holes
  2. Boring holes
  3. Fitting holes
  4. Gluing

PP. Use of a file to smooth inside and outside curves

QQ. Selection of the correct file

HAND TOOLS

Proceed with the making of Project #1, "The Cutting Board". This project involves most of the hand tool processes decribed and observance of good techniques. (References: 6, 23).

Arrange Project #1 "The Cutting Board" using glue for permanent fastening of joints as in reference 23.

Make a doweled joint with or without using a jig. Butt joints are frequently reinforced by using dowels. Precise workmanship is required on this operation, and accuracy of measurement is essential.

(References: 4, 6, 7, 9, 12, 15, 16, 23, 24, 26).

Have students glue a butt joint as a class demonstration using clamps to hold the joint. Have students use several kinds of glue on test samples to determine characteristics of each kind. Glued joints require that pressure be applied to hold the pieces together. Pressure may be obtained by using screws, nails, vises, or clamps. The glue joint in "The Cutting Board", Project #1, can be held by pressure with clamps. Doweled or mortise and tenon joints must be held with clamps until the glue has set. Good mortise and tenon joints require snug fits and are an essential joint in furniture construction. (References: 4, 6, 7, 9, 12, 15, 23, 24).

Project #3, "A Knife Rack". (References: 4, 23, 26).

Demonstrate carefully the techniques of using the file. Inasmuch as the file is so frequently misused, it is highly important that students understand the proper times for using the ile and the plane. Constantly check student's usage of this tool. Use and have students use a back-up piece of wood when filing. The file must always have a handle. (References: 4, 6, 9, 12, 15, 23, 24).

UNIT IV: POWER TOOLS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Safe operation of power tools
understand safe work habits with power equipment	B. Regulations for student use of power tools
	C. Correct procedures of use of power machinery
develop ability to make adjustments and acquire skill in the use of the jig saw	D. Use of the scroll or jig saw
	1. Making of adjustment on the saw
develop ability in making operating adjustment and obtaining skill in the use of this machine	2. Operation of scroll saw
	a. Cutting outside curves b. Cutting inside curves
understand how to use the band saw safely	3. Selection of proper blades
	E. Use of the drill press
	1. Adjustments on drill press
	2. Operation of drill press
	a. Fastening drill in chuck b. Drilling to given depths c. Countersinking d. Drilling through holes
	F. Use of the band saw
	1. Making of adjustments on the band saw
	2. Operation of the band saw

SUGGESTED LEARNING EXPERIENCES

Check to make sure each student has on file a parent's permission blank to use power machinery.

Stress the importance of strict attention to the operation of the machine. Most accidents occur when the operator becomes careless.

(References: 9, 15, 23, 24).

Explain that nearly every saw cut that is curved or irregular in contour is a possible cut that can be made on the jig saw.

Arrange demonstrations of the proper and safe techniques in selecting and installing the jig saw blade; make necessary operating adjustments including inside and outside curve sawing. Post directions for installing blades on machine. Teach where power may be cut off.

(References: 6, 7, 9, 11, 12, 15, 20, 23, 24, 25).

Arrange exercises in drilling through holes, and drilling holes to a required depth.

Make adjustments in the speed of the drill press to compensate for the type of bit being used, the size of the drill bit, and the material being drilled.

(References: 6, 9, 11, 12, 15, 24, 25).

Explain what operations are to be done on the band saw and those to be done on the jig saw. The band saw is used for thick cuts and the jig saw is used on thin wood and for interior cuts.

Demonstrate the proper use of the band saw with special reference to safety procedures. Be sure to caution students about keeping hands away from the blade.

(References: 6, 7, 9, 11, 15, 20, 23, 24, 25).

learn to prepare stock for spindle turning in the lathe

develop some degree of skill in spindle turning on the lathe

become proficient in doing face plate turning on the lathe

G. Kinds of lathe tools

1. Gouges
2. Skews
3. Parting tools
4. Rount nose tools
5. Spear point

H. Use of the lathe

1. Preparation of stock
2. Spindle turning
    a. Rough turning using gouge
    b. Finish turning using skew
    c. Squaring off ends
    d. Cutting a shoulder
    e. Cutting tapered surface
    f. Cutting V's
    g. Cutting beads
    h. Turning concave surfaces
    i. Turning convex surfaces
3. Face plate turning

POWER TOOLS

Examine the lathe with the students. Explain the various parts of the lathe and demonstrate the way in which the lathe functions.

Prepare a piece of stock for spindle turning in the lathe.

Demonstrate the securing of the stock in the lathe before turning.

Make some cuts with each of the lathe tools to show how each is properly used.

(References: 6, 9, 11, 12, 15, 20, 24, 25).

Have students make a project by spindle turning on the lathe, such as Project #4, "A Vise Handle", or Project #6, "A Candelabra." (References: 5, 6, 9, 11, 12, 13, 14, 15, 20, 24, 25).

Demonstrate the procedures involved in doing simple face plate turnings.

Have students make Project #5, "A Jewel Box."

(References: 6, 7, 9, 11, 12, 14, 15, 20, 24, 26).

UNIT V: ASSEMBLING AND FINISHING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Sandpapers and sanding
develop skill in hand sanding operations	B. Correct procedures in sanding
	1. Selection of proper grit
develop ability in using hand and machine tools through making attractive projects	2. Necessity of sanding with grain of wood
	3. Sanding flat surfaces with sandpaper on a block or with a flat surface
understand how to apply wood filler, stain, wax, shellac, enamels, varnishes, and lacquers	C. Tool experiences in making and assembling projects
	D. Basic finishes for woodworking
gain a degree of skill in applying finishes	1. Wax
	2. Enamel
develop correct habits of care for cleaning, painting, and finishing materials.	3. Varnish
	4. Lacquer
	5. Shellac
	E. Care of brushes and finishing
	1. Use
	2. Cleaning
	3. Storage

SUGGESTED LEARNING EXPERIENCES

Exhibit the various coarse sand papers and point out the difference between garnet paper and flint paper.

Illustrate correct procedures in limbering, cutting, or tearing, and using sandpaper to produce the finished surface.

(References: 4, 6, 7, 9, 15, 22, 23, 24).

Provide students with experiences in making several projects.

Project #7, "A Book Rack". (References: 4, 6, 8, 15).

Project #8, "Match Box Holder". (References: 6, 14).

Project #9, "Note or Desk Box". (References: 1, 6).

Project #10, "Tray". (References: 1, 5, 6, 7, 8, 9, 12, 15, 23, 26).

Project #11, "Book Ends". (References: 3, 5, 6, 7).

Project #12, "Shoe Shine Box". (References: 4, 6, 7, 22, 23).

In each of the foregoing projects have students apply a finish such as wax, enamel, varnish, or lacquer. Each student should apply each of the above finishes at least once. Demonstrate the application of each finish. (References: 4, 6, 7, 9, 12, 15, 23, 24).

Emphasize the safety precautions necessary when using finishing materials. Oily cloths or rags should be disposed of as quickly as possible. Use fireproof containers for storing paints and thinners. Clean all brushes after using, or place them in suitable storage containers with the proper solvent. (References: 1, 2, 3, 4, 5, 6, 7, 9, 12, 15, 22, 23, 24, 26).

UNIT VI: WOODS AND LUMBERING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Sources of lumber
know the location of our forest lands and where certain kinds of trees grow	1. Hardwood forests 2. Softwood forests
	B. Production of lumber
know how lumber is produced from logs, and how lumber is seasoned	C. Grading of lumber D. Recognition of lumber
develop some understanding of the various grades of lumber	1. Hardwoods-broadleaf trees 2. Softwoods-evergreen trees
	E. Classification of wood
learn to identify the common hardwoods and softwoods	1. Open grain 2. Closed grain
understand the term "board feet" and develop some degree of skill in computing board measure	F. Units of measure for lumber 1. Lineal foot 2. Board foot
understand the computing of pieces of materials required for a job	3. Square foot G. Computation of board feet

SUGGESTED LEARNING EXPERIENCES

Show movies, slides, and/or film strips on forest lands, lumbering, logging, drying, marketing, and distribution. Acquaint students with these aspects of the wood industries. Describe sizes of rough sawed boards and compare them with finished sizes.

Present such terms as, "selects and better", "30% F.A.S. (30% firsts and seconds)", "70% selects", "#1 common". Grading lumber is a very technical operation, and only the elementary phases can be presented to high school students.

Teach other terms such as K.D. (kiln dried) "S2S" (surface 2 sides), R.W. & L. (random widths and lengths). These terms are essential for the intelligent purchase of lumber.

(References: 4, 6, 7, 9, 10, 12, 15, 23, 24, 26).

Have display samples of the various kinds of common hardwoods and softwoods available for student examination.

Point out the characteristics of each kind of wood and the differences that exist between hardwoods and softwoods.

Emphasize the slection of proper wood for a given project. The proper selection depends on indoor or outdoor uses, strength, appearance, hardness, water resistance, and the like. Help the students to understand this.

Show samples of open and closed grain woods. Explain how each is used. Carefully describe the characteristics of the woods as students begin to work with each kind. This gives students an opportunity to observe these characteristics as they work with such woods as basswood, poplar pine, oak, walnut, and mahogany.

Use diagramatic illustrations or visual aids to show how much lumber is represented by one board foot. The simple mathematics of computing the number of board feet in a board should be demonstrated. Have students compute the number of board feet in several problems, and then compute the costs in each of these problems.

learn something of the costs of various kinds of lumber	H. Making of a bill of material and computing of the cost of materials
know the sizes of lumber stocked in lumber yards.	I. Cost of lumber
	J. Sizes of lumber

WOODS AND LUMBERING

Choose a project and from this make a bill of materials for class instruction and compute costs item by item and the total cost.

Have students make a bill of material as an assigned project.

Use lumber company price lists to acquaint students with current prices of the kinds of hardwood lumber being used in the school shop. Point out why poplar or basswood cost less than black walnut or cherry.

Teach students that softwoods are usually sold in such sizes as 1x2, 1x4, 1x6, 1x10, 1x12, and 2x4, 2x6, 2x8, 2x10, 2x12, and in lengths of 6'-0, 8'-0, 10'-0, 12'-0, 14'-0, and 16'-0 long.

Hardwoods are sold usually in random widths and lengths.

(References: 4, 6, 7, 9, 10, 12, 15, 23, 24, 26).

WOODWORKING II

UNIT I: PLANNING

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Reading of working drawings
develop ability to read and interpret working drawings	1. Line conventions
	2. Three view drawings
compute lumber and other material costs, such as plywood, wall board, and hardware	3. Pictorial drawings 4. Dimensioned drawings
	B. Computing of lumber costs
develop some ability in laying out parts of furniture.	1. Computing board feet
	2. Computing square feet
	3. Computing lineal feet
	C. Preparation of bill of material
	1. Inventory of parts
	2. Compute cost of each
	3. List hardware and prices of each part
	D. Preparation of layout

PLANNING

SUGGESTED LEARNING EXPERIENCES

Have students prepare a stock list of materials from a working drawing of a project.

Have students make a full size pattern on paper of an irregularly shaped piece or pieces preparatory to layout on wood.

(References: 4, 6, 7, 9, 23, 24).

Have students, using the stock list prepared from above, compute the number of board feet in each piece of material. Then combine these parts of the same kind of lumber to determine the number of boards to purchase. Then compute the cost of these boards. Plywood, hardboard, and others are computed on a square foot basis. Items of hardware are sold usually on a cost per item basis. Compute the costs of one of the projects comtemplated. (References: 6, 9, 10, 23).

Have students lay out a project cutting several of the parts from one piece of wood. Lay out irregular pieces on wrapping paper first, then cut out before transferring to the wood. Have all parts checked by the instructor or shop foreman before cutting. (References: 4, 7, 9, 23, 24).

UNIT II: POWER MACHINES

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Sanding machines
develop skill in the use of the sanding machine: belt, disc, oscillating, and portable belt sanders	1. Disc sander
	2. Belt sander
	3. Spindle sander
gain experience in using the jointer and planer (if available)	4. Portable orbital sander
	5. Portable belt sander
	B. Adjustment of sanders
develop an understanding, an appreciation, and skill in using the circular saw	C. Use of sanders
	D. Use of jointers and planers
	E. Safe procedures in using the jointer and planer
	F. Use of circular saws
	1. Crosscutting on the saw
	2. Ripping on the saw
	3. Dado cuts with the saw
	4. Necessary adjustments for depths of cuts
	5. Safe procedures in operating the saw
	G. Supervision of students using machinery

SUGGESTED LEARNING EXPERIENCES

Teach students to use the most appropriate tool for each type of job.

Never permit students to use a sanding machine whenever a plane or cutting tool should be used.

Teach students that small parts can often be sanded on the belt or disc sanding machine. Caution students not to force the work into the machines.

Help students understand that larger pieces of wood or assembled furniture can be finished with an orbital or oscillating sander.

Explain that portable belt sanders are frequently used for finishing rough surfaces such as bench tops.

(References: 6, 11, 12, 20).

Be sure that basic skills are developed in the use of the hand plane before students attempt to use either the jointer or planer.

Make certain that students are thoroughly instructed in the use of the jointer and that only safe procedures are employed when using it.

Have students study the jointer and planer carefully; learn how adjustments are made for depth of cut; and how the wood should be fed into the machine. Always have a pusher stick available and use it on the jointer.

(References: 6, 9, 11, 12, 15, 20, 24, 25).

Brief students thoroughly in the correct and safe methods of using the circular saw. Experience should be gained in crosscutting, ripping, and making dado cuts. Learning to cut stock into the same lengths and widths is a valuable experience. (References: 6, 9, 11, 12, 15, 20, 24, 25).

develop attitudes and appreciations appropriate in using power machines

develop skill in operating portable router, miter box, and in making miters on a miter vise.

H. Supervision of safety conditions involving all power machinery

   1. Safety zones

   2. Students' clothing

   3. Goggles

   4. Operating condition of machines

   5. Proper operation

I. Safe procedures in using other machines and attachments such as routers, miter boxes, and miter vises

POWER MACHINES

Check the safety of each machine to see that it is in proper operating condition, that the cutting knives or teeth are well sharpened, and that the guards are functioning.

Check students' wearing apparel: no long sleeves or ties to catch in moving parts; shop aprons and goggles are to be worn whenever necessary.

Have safety zone stripes painted on floor around each machine, and teach all students except the operator to stay out of this zone.

Use floor mat or abrasive paint on floor for operator of circular saw and jointer.

Give complete instructions and demonstrations covering each machine. Closely observe each student's first experience using each machine and make constructive suggestions. After operations are completed, proper adjustments on machines should be made, such as turning the blade down on the circular saw. Make sure all these items are carefully observed.

Explain when, where, and how the portable router is used, as well as the most often used cutter bits. Provide students with an opportunity of using this machine.

Provide students with an opportunity to use miter boxes and miter vises even though they are special machines for special uses.

(References: 6, 7, 9, 20, 23).

UNIT III: PROJECTS AND PROCESSES

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Operations in face plate turning
develop skill in face plate turning	1. Selection of woods to use
	2. Jointing surfaces
learn the basic principles of cutting stock	3. Gluing-up
	4. Preparation for the lathe
know how to make woodworking joints: butt, dowel, rabbet, dado, lap, miter, mortise and tenons	5. Preparation of template
	6. Use of lathe tools
	7. Sanding of bowl
develop skills in the use of power machines	8. Application of finish
	B. Selection of stock
develop ability in making and using templates and jigs	C. Setting up of saw to cut duplicate parts
	D. Use of safe operating practices
	E. Construction of woodworking joints
	F. Use of power machinery in making joints
	G. Use of machine equipment
	H. Cutting and fitting of project parts
	I. Use of templates and jigs
	J. Making of patterns, templates and jigs

SUGGESTED LEARNING EXPERIENCES

Have students complete Project #13, " A Turned Nut Bowl." This project will provide experience in face plate turning on the wood lathes. (References: 9, 13, 14, 15, 22, 26).

Help students develop a thorough understanding of and provide some experience in using the circular saw. This is essential since in the school shop most lumber is cut to size on the circular saw.

Have students lay out stock to be cut, set up saw to cut material, make all straight cuts first, and if any curves are to be made, set this up for the band or scroll saw and proceed to cut.

(References: 4, 6, 23).

Explain and demonstrate, by use of models and diagrams, the common joints used in woodworking. Each of these joints has variations for particular uses. Likewise each of these joints is better suited to one type of construction. For example, a dowl joint is better than a butt joint when gluing up a table top.

Show students each type of joint that is used.

Provide projects that give students experience in making these joints. As the projects are described in the references listed below, the joint required will be shown in the drawing of the project.

(References: 4, 6, 7, 9, 12, 15, 23, 24, 26).

As the students progress through the course, expect more skill in their use of machines, as well as the acceptance of more responsibility. Cutting of stock, making joints, and fitting of various parts of projects, now should be done by machine although the student earlier learned to do these details by hand. (References: 6, 9, 11, 12, 15, 20, 24, 25).

Determine when templates, jigs, and patterns will either speed up work procedures or aid in producing a higher quality workmanship. Students should make templates and patterns for the parts of the next project they are going to build.

develop ability in building cabinets	K. Construction of drawer
	L. Operations in drawer construction
develop skill in drawer construction	M. Use of plywood and veneers
	N. Manufacture of plywood veneers and wallboards
develop ability in cutting and fitting plywood in furniture construction.	

Demonstrate by sketches the several different methods of drawer construction pointing out the advantages of dovetail joints over rabbeted joints. Study other kinds of joints used in drawer construction. (References: 4, 7, 9, 12, 26).

Assign Project #14, "Cabinets", to students. This project involves many of the basic steps in woodworking including cutting and fitting of parts, gluing of joints, construction of drawer, fitting of drawer, sanding and finishing of drawer, and application of drawer pulls. (References: 15, 23).

Demonstrate by use of charts and sketches how plywood and veneers are manufactured.

Have a disply of different samples of plywood and veneer, i.e., 3-ply, 5-ply, 7-ply; finished hardwood veneer over a softwood core; and the common varieties of wall board.

Discuss proper uses of plywoods and veneers in projects and home building.

Discuss wall boards, their manufacture, use, and fabrication.

(References: 4, 6, 7, 9, 10, 12, 15).

UNIT IV: FINISH AND ASSEMBLY

UNDERSTANDINGS

The student should:

- become skillful in assembling projects
- develop skill in applying filler, stain, shellac, varnish, enamel, lacquer, and wax
- learn how and where hardware should be applied
- develop skill in building a box or chest

OUTLINE OF CONTENT

A. Temporary assembly of work

B. Final assembly of work

C. Preparation for and application of finishes

D. Knowledge of the basic finishes

E. Selecting of hardware

F. Attaching of hinges and cabinet hardware

G. Operations in box construction

SUGGESTED LEARNING EXPERIENCES

Fit all parts together before gluing, identifying each member so that each is assembled in the correct location.

If wood screws are to be used, have all pilot holes drilled and countersunk. Check to see that all parts are sanded. Have protective pieces of wood available to keep finished surfaces from becoming damaged by the clamps.

Temporarily assemble project and make any needed adjustments.

Assemble with glue, clamps, or screws and nails for the final time. Wipe off surplus glue.

(References: 1, 4, 6, 7, 9, 26).

Many of these finishes have no doubt already been used by the students. Present information at this point covering methods of preparation for and the application of the common finishes even though students may have used these finishes previously.

1. Make sure all surfaces are clean, free of dirt, pencil marks, and other marks

2. Sand surfaces smooth, free of all scratches and abrasive marks

3. Determine the kind of finish desired

4. Apply the desired finish according to correct procedures.

Make panels of wood samples with various finishes available.

(References: 1, 2, 4, 6, 7, 9, 12, 14, 15, 23, 24, 26).

Provide students with opportunities to study location of hardware on projects, with a view as to pleasing design and functional application.

Demonstrate the proper method of attaching a pair of butt hinges, ornamental hinges, ornamental hasps, and drawer pulls.

(References: 4, 6, 7, 9, 12, 23, 24).

Assign Project #15, "Chest or Box." Operations in the construction of a box includes a number of steps in sequence: secure bill of material, make layout, cut out parts, square-up prices, check parts, assemble, removal of excess glue, sand, finish, and application of hardware. (References: 1, 5, 13, 22).

develop ability to make a small project	H. Operations in making a lamp
	I. The gouge
develop skill in using the gouge	1. Inside bevel
	2. Outside bevel
understand how to grind and whet a gouge	J. Uses of the gouge
	K. Grinding and whetting of gouges
become skillful in drilling holes and counterboring them	L. Drilling and counterboring of holes
	M. Selection of drill or bit
	N. Countersinking and plug filling of holes

FINISH AND ASSEMBLY

Assign Project #16, "Lamp". Operations include getting bill of material, making layout, cutting stock, drilling for pipe, and the like. (References: 3, 4, 8, 9, 12, 15, 22, 26).

Demonstrate the use of gouge; show difference between gouges with bevel on the outside and those with bevel on the inside. (References: 4, 6, 7, 9, 12, 20, 23).

Point out the different ways in which inside bevel and outside bevel gouges have to be ground. Demonstrate the whetting of the gouges and the shape of the slip stone used. Provide students with the opportunity to whet gouges. (References: 7, 12, 15, 20, 23).

Demonstrate proper techniques in using hand drill, breast drill, portable power drill, and drill press in using the twist drill. Show also how to use a depth gauge to drill holes to given depth. Also demonstrate how to counterbore a hole. Drilling and counterboring are essential operations in furniture construction.

Use drill gauge to identify size of drills.

(References: 7, 9, 12, 23).

Demonstrate the use of countersink to countersink holes. Show procedure for different size screw heads. Show how to cut plugs with a plug cutter.

Demonstrate the filling of a counterbored hole with a plug.

Have students drill, counterbore, and plug fill holes in one of the assigned projects. (References: 4, 6, 7, 9, 12, 23).

develop skill in making a piece of furniture	O. Operations in making a piece of furniture
	P. Operations in making a wall shelf

FINISH AND ASSEMBLY

Have students make a "Telephone Stand", Project #17. This project includes the following steps:

1. Basic steps
2. Layout joints
3. Fit joints
4. Temporarily assemble
5. Disassemble temporarily
6. Permanently assemble
7. Clean
8. Finish
9. Apply hardware.

(References: 8, 24, 26).

Have students make a "Wall Shelf", Project #18. This involves the following operations:

1. Basic steps
2. Layout of joints
3. Fit joints
4. Temporarily assemble
5. Disassemble temporarily
6. Permanently assemble
7. Clean
8. Finish
9. Apply hardware.

(References: 6, 8, 9, 15, 23, 26).

develop skill in miter drawing	R. Miter sawing on a miter box
	S. Miter sawing on a power saw
understand the use of wood bits and braces	T. Braces, corner braces, tees, brackets and clips
understand when and how to use the spokeshave	U. Use of hardware for braces
	V. The spokeshave
understand the use of the saw	W. Assembling, adjusting, and sharpening of the spokeshave
	X. Keyhole sawing
develop ability to build a birdhouse or similar project	Y. Operations in making a birdhouse

FINISH AND ASSEMBLY

Demonstrate the correct way to make a miter on all the machines found in the shop. Miter sawing may be done on the miter box, circular saw, band saw, or in the miter vise.

Provide opportunities for students to make miter joints on each of these machines.

(References: 4, 6, 7, 12, 23).

Have a display of various kinds of braces used in woodworking; appropriately label each kind of brace, such as tee plate, corner angle, straight plate, shelf bracket, and desk top clips.

When making the projects, such as the coffee table or telephone stand, use desk top clips or some other device as the straight mending plate.

(References: 7, 23, 26).

Demonstrate how the spokeshave is used to finish a curved surface. The spokeshave is not used nearly as much as it was at one time but still has a few specialized uses.

Demonstrate the use of the keyhole saw when sawing an inside curve. It is used when the coping or turning saw has limitations because of its back.

(References: 4, 6, 7, 9, 23).

Assign Project #19, "Birdhouse". This involves the following operations or learning experiences:

1. Layout of parts
2. Cutting parts
3. Fitting joints
4. Boring holes
5. Fitting parts together
6. Assemblying
7. Finish

(References: 6, 9, 16, 23).

build a standard piece of furniture

know the commonly used woods for furniture making

understand the process of producing and seasoning lumber

understand the bases of grading lumber.

Z. Operations in making a coffee table

AA. Commonly used kinds of lumber

BB. Production of lumber

CC. Grading of lumber

Have students make a "Coffee Table", Project #20. This project requires the use of the following learning experiences:

1. Layout
2. Cutting parts
3. Fitting parts
4. Layout parts
5. Fitting joint
6. Assembly
7. Final sanding
8. Finish
9. Apply hardware

Utilize movies, slides, or film strips to show the sawing of logs into lumber, and the sorting and stocking of lumber.

Include a visual presentation of the drying of lumber, in the open or kiln dried.

Describe sizes of rough sawed boards and how they compare with finished sizes of the lumber.

(References: 4, 6, 7, 9, 10, 12, 23, 24, 26).

Discuss the grading of lumber. This is a very technical operation and only the elementary phases can be presented to high school students.

Such terms as: "Selects and Better"
"30% FAS" (30% Firsts and Seconds)
"70% Selects"
"No. 1 Common"
should be understood.

Help students develop an understanding of terms, such as "KD" (Kiln Dried), "S2S" (Surface 2 Sides), "RW&L" (Random Widths and Lengths). These terms are essential for the intelligent purchase of lumber.

(References: 4, 6, 9, 10, 23, 23, 26).

UNIT V: SUPPLEMENTARY TOPICS

UNDERSTANDINGS

The student should:

- develop skill in small upholstery projects
- understand the simple elements of patternmaking
- develop ability to make small patterns
- develop an understanding of pattern terms
- develop skill in working to exact dimensions in making patterns

OUTLINE OF CONTENT

A. Simple upholstery

B. Commercial upholstery

C. Patternmaking

D. Foundry practices

E. Production casting

F. Construction of a pattern

G. Pattern terms

H. Operations making a simple pattern

SUGGESTED LEARNING EXPERIENCES

Demonstrate to students the fundamentals of upholstering a footstool. Small projects frequently are upholstered.

Use movies or possibly a trip to a furniture factory to view.

(References: 4, 7, 12, 15, 24).

Explain the purposes for which patterns are used.

Explain the relationship between patternmaking, foundry practice, and production casting.

(References: 21).

For discussion enlarge a pattern using a visual aid. Explain pattern, draft and shrinkage, simple pattern, simple built-up pattern, core boxes, core pattern with core prints and core box, and a parted pattern.

(References: 21, 26).

Assign Project #21, "Simple Pattern". Develop skill in the operations involved in making a simple pattern including:

1. Pattern sketch
2. Layout
3. Use of shrink role
4. Cut stock
5. Plane
6. Fillets
7. Sand
8. Finish.

(References: 21, 26).

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FILMS

The visual aids which follow are listed in Classroom Motion Pictures, Filmstrips, and Art Slide Sets, Chicago Public Schools, 1961, and Approved List of Filmstrips for Elementary and Secondary Schools, Chicago Board of Education, 1961.

ABC of Hand Tools: Part I and II. Gen. Mot.-Walt Disney Productions, 1946. 30 min. color (X-T-43).

Claw Hammer and Nail Set. Tompkins Films, 1952. 11 min. color (X-C-102).

Drilling in Metal, Wood or Plastics. Castle Films Dept., United World Films, Inc., 1943. 23 min. b&w (X-D-13).

Essentials of Wood Turning. Bell and Howell, 1941. 10 min. b&w (X-W-17).

Forest Conservation. Encyclopaedia Britannica Films, Inc., 1949. 11 min. color (X-F-89).

Forest Grows. Encyclopaedia Britannica Films, Inc., 1949. 11 min. color (X-F-90).

Forest Produces. Encyclopaedia Britannica Films, Inc., 1949. 11 min. color (X-F-91).

Forestry and Forest Industries. Carl F. Mahnke Prod., 1946. 11 min. b&w (X-G-33).

Furniture Craftsmen. Encyclopaedia Britannica Films, Inc., 1940. 11 min. b&w (X-F-16).

The Hand Plane. Tompkins Films, 1952. 11 min. b&w (X-H-77).

Hand Sawing. The Jam Handy Organization, 1943. 20 min. b&w (X-S-45).

Hand Saws, Crosscut and Rip. Tompkins Films, 1952. 11 min. color (X-H-78).

Industrial Arts: A Safe Shop. Young America Films, Inc., 1955. 11 min. b&w (X-I-55).

Industrial Arts: Boring and Drilling Tools. Young America Films, Inc.-Centron Productions, 1954. 11 min. b&w (X-I-50).

Industrial Arts: Chisels and Gouges. Young America Films, Inc.,-Centron Productions, 1954. 11 min. b&w (X-I-49).

Industrial Arts: Using Screws and Nails. Young America Films, Inc., 11 min. b&w (X-I-47).

The Lumberman. Firth Films, 1941. 22 min. color (X-L-11).

The Lumber States (U.S.A. - The Pacific Northwest). United World Films, Inc., 1945. 20 min. b&w (X-N-53).

Molding With A Loose Pattern. Government Films Dept., United World Films, Inc., 1944. 21 min. b&w (X-M-108).

Molding With A Split Pattern. United World Films, Inc., 1945. 19 min. b&w (X-M-134).

SUPPLEMENTARY TOPICS

Shop Procedures. McGraw-Hill Book Co., Text-Film Dept., 1947. 17 min. b&w (X-S-77).

Simple Machines. Encyclopaedia Britannica Films, Inc., 1942. 11 min. b&w (X-M-40).

The Steel Rule. Castle Films Dept., United World Films, Inc., U. S. Office of Education, 1942. 10 min. b&w (X-M-41).

Use and Care of Hand Files. The Jam Handy Organization, 1942. 20 min. b&w (X-F-33).

Woodmachining: Turning A Cylinder Between Centers. Government Films Dept., United World Films, Inc., 1944. 17 min. b&w (X-W-7).

Woodmachining: Turning Taper Work. Government Films Dept., United World Films, Inc., 1944. 12 min. b&w (X-W-8).

Woodmachining: Turning Work In A Chuck. Government Films Dept., United World Films, Inc., 1944. 15 min. b&w (X-W-10).

Woodmachining: Turning Work On A Face Plate. Government Films Dept., United World Films, Inc., 1944. 15 min. b&w (X-W-9).

The Woodworker. Carl F. Mahnke Prod., 1940. 11 min. b&w (X-G-12).

FILMS FROM OTHER SOURCES

The following films may be ordered from the McGraw-Hill Book Company, Text-Film Department, 330 West 42nd Street, New York 36, N.Y.

Boring and Drilling Tools.	12 min. $60.00.
Chisels and Gouges.	13 min. $65.00.
Hand Saws.	10 min. $60.00.
Jointing and Gluing.	14 min. $75.00.
Knowing Woods and Their Uses.	13 min. $75.00.
Measuring and Squaring.	12 min. $60.00.
Planes.	13 min. $65.00.
A Safe Shop.	11 min. $60.00.
Using Screws and Nails.	12 min. $60.00

Wood Finishing. $85.00

Why Study Industrial Arts. 10 min. $60.00.

FILMSTRIPS

Film strips are available from private sources and some are listed here for your convenience:

The Jim Handy Organization
230 North Michigan Avenue
Chicago 1, Illinois

Basic Shop Safety

1. Play Safe and Work Safely - 77 frames.
2. Maintaining A Safe Shop - 64 frames.
3. Safety Inspection - 53 frames.
4. Training for Emergencies - 101 frames.
5. Treatment for Bleeding, Shock, Preventing Infection - 101 frames.
6. Aid for Injuries, Fainting, Burns - 94 frames.
7. Eye Protection - 82 frames.
8. Power Supply - 120 frames.

Above series $34.65 or $4.95 each strip.

Woodworking Tools and Machines

1. Hand Tools, Hammers, Saws - 67 frames.
2. Planes, Bits, Knives, Chisels, Screwdrivers, Files - 72 frames.
3. Tool Grinder - 63 frames.
4. Drill Press - 82 frames.
5. Jig Saw - 96 frames.
6. Band Saw - 89 frames.
7. Disk Sander - 48 frames.
8. Belt Sander - 84 frames.
9. Lathe: Parts - Spindle Turning - 86 frames.
10. Lathe: Faceplate Turning - Other Operations - 74 frames.
11. Planer - 75 frames.
12. Jointer - 83 frames.
13. Circular Saw: Parts - Installing A Blade - 76 frames.
14. Circular Saw: Setting Up - Operating - 64 frames.

Complete series $59.40, individual strip $4.95.

McKnight and McKnight Publishers
Bloomington, Illinois

1. Lumbering of Hardwoods.
2. Processing Hardwood Lumber.
3. Finishing I.
4. Finishing II.
5. Safety.
6. Design.

Set of 6 filmstrips $45.50.

Stanley Tool Works
New Britain, Connecticut

1. Hand Saws for Woodworking

    A. Type of Hand Saws - 10 frames.
    B. Crosscut Saws and Ripsaws - 20 frames.
    C. How to Use the Crosscut Saw and the Rip Saw - 10 frames.
    D. How to Use the Back Saw and the Dovetail Saw - 12 frames.
    E. How to Use the Compass Saw and the Keyhole Saw - 10 frames.
    F. How to Use the Coping Saw and the Turning Saw - 14 frames.
    G. How to Use the Mitre Box - 24 frames.
    H. How to Use the Picture Frame Mitre Machine - 14 frames.
    I. How to Sharpen Hand Saws - 27 frames.

2. Hammers, Screwdrivers, Nails and Screws

    A. Types of Nail Hammers and Nail Sets - 11 frames.
    B. Information About Hammers and Nail Sets - 16 frames.
    C. How to Use Hammers and Nail Sets - 28 frames.
    D. Nails - 20 frames.
    E. Types of Screwdrivers - 19 frames.
    F. Preparation for Driving Screws - 12 frames.
    G. How to Select a Screwdriver - 11 frames.
    H. How to Use the Screwdriver - 24 frames.
    I. Wood Screws - 8 frames.

3. Boring Tools for Woodworking

    A. Types of Boring Tools - 23 frames.
    B. Holding and Boring Tools and Accessories - 11 frames.
    C. How to Bore a Hole - 23 frames.
    D. How to Use the Doweling Jig - 15 frames.
    E. How to Use Expansive Bits, Forstner Bits, Brad Awls - 21 frames
    F. How to Use Hand and Breast Drills - 15 frames
    G. How to Use Push Drills and Spiral Ratchet Screwdriver to Bore Holes - 16 frames.
    H. Boring Tools for Use in Electric Drills - 15 frames.

I. How to Sharpen Boring Tools - 12 frames.

4. Chisels for Woodworking

A. Types of Chisels - 16 frames.
B. How a Chisel Cuts - 20 frames.
C. Cutting Notches, Gains, Rabbets - 18 frames.
D. Cutting Half Lap Joints - 10 frames.
E. Cutting Mortise and Tenon Joints, Dovetails - 24 frames.
F. Grinding Chisels - 16 frames.
G. Whetting Chisels - 10 frames.
H. Special Chisels and Gouges - 14 frames.
I. Grinding and Whetting Gouges - 11 frames.

5. Measuring, Testing and Marking Tools for Woodworking

A. Foot and Inch Graduation - 13 frames.
B. Bench and Folding Rules - 10 frames.
C. Zig-Zag and Extension Rules - 17 frames.
D. Pull-Push and Caliper Rules - 9 frames.
E. Types of Squares - 25 frames.
F. T-Bevel and Angle Divider - 13 frames.
G. Marking and Mortise Gauges - 18 frames.
H. Pencils, Knives, and Scratch Awls - 9 frames.

6. Planes

A. Types of Bench Planes - 24 frames.
B. Plane adjustments - 15 frames.
C. How to Plane A Broad Surface - 14 frames.
D. How to Plane and Edge Straight - 11 frames.
E. End Planing - 11 frames.
F. Chamfers and Bevels - 8 frames.
G. Grinding the Plane Iron - 14 frames.
H. Whetting the Plane Iron - 15 frames.
I. Correction of Poor Planing - 14 frames

Each of these Stanley sets are available from Stanley Tool Works, New Britain, Connecticut @ $5.00 per set.

FIELD TRIPS

Well arranged and properly conducted field trips can afford unusual opportunities for students. The complete story of the lesson to be learned can often be seen through an occasional visit to facilities dealing with raw materials, semifinished products and the marketable object. The field trip should provide students with an experience that cannot be duplicated in the school shop.

For a well planned field trip the teacher should:

1. Plan the trip well in advance, in an industry related to the work done in the woodshop.
2. Make certain that the administration, the management of the industry visited, and the students know the reason for the visit.
3. Schedule the trip at a time which is most suitable for the school and the plant.
4. Arrange with the plant management for competent guide or guides through the plant.
5. Prepare the students on regulations for the trip and things that should be observed.
6. Arrange for transportation (if needed) and parental permission.
7. After the trip, discuss the important things observed and enumerate the valuable learning experiences.

The tours listed are just a few suggestions; there are many others that may prove to be of equal value.

Museum of Science and Industry, East 57th Street and South Shore Drive. See Exhibit on Woods.

Marshall Field & Company, State and Randolph Streets. See exhibit of fine furniture.

Visit local lumber yard with a tour through the mail room. Contact manager.

Inspect a new building in your neighborhood; contact contractor for permission.

TEACHER'S NOTES

WOODWORKING III INTRODUCTION

Third semester woodworking begins cabinetmaking; this continues through the fourth semester.

A greater degree of skill should be developed and work of a more professional quality should be expected. Specialized hand tools and power machines are used in making pieces of furniture.

Students' abilities will become clearly defined. The instructional program should be adjusted to meet the needs of each student.

Power woodworking machinery was used in an elementary way during the first two semesters, but more attention is given to advanced techniques of machine woodworking in the third semester, and students should learn not only to use the machines safely but also skillfully.

UNIT I: ORIENTATION

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Orientation of students in the shop
review past experience in the use of woodshop tools	1. Welcome
	2. Class organization
review sharpening of planes, chisels and auger bits.	B. Review of tool nomenclature
	C. Necessity of equipment
	1. Shop
	2. Personal

SUGGESTED LEARNING EXPERIENCES

Make the student feel welcome and "at home" by a friendly greeting, and explain in brief the scope of work to be done during the semester. A few questions regarding the summer activities of students helps establish rapport between the student and the instructor.

Inform the class of equipment needed to work in the shop. Apron (clean), cloth for staining and polishing, shop fee, 12" rule, notebook and lead pencil (to use on wood), and hand towel and soap are important items.

Stress that items mentioned will be needed beginning the next day, especially notebook, rule, and shop fee.

Demonstrate again, as a review, how to whet a plane blade or chisel, and how to sharpen an auger bit.

Check credits earned in previous shop courses if such a plan is followed in your school.

Review shop and school rules for conducting an orderly and efficient class.

Check in shop equipment regularly.

Discuss projects suitable to construct, taking into consideration storage room available, ability of the student, and lumber needed. Students should consult with their parents regarding project size, finish and type of wood.

Allow a half-hour for students to browse through projects shown in books in the room library. Help the students in the selection of projects in relation to their past ability. Advise that a shop drawing of the project is necessary.

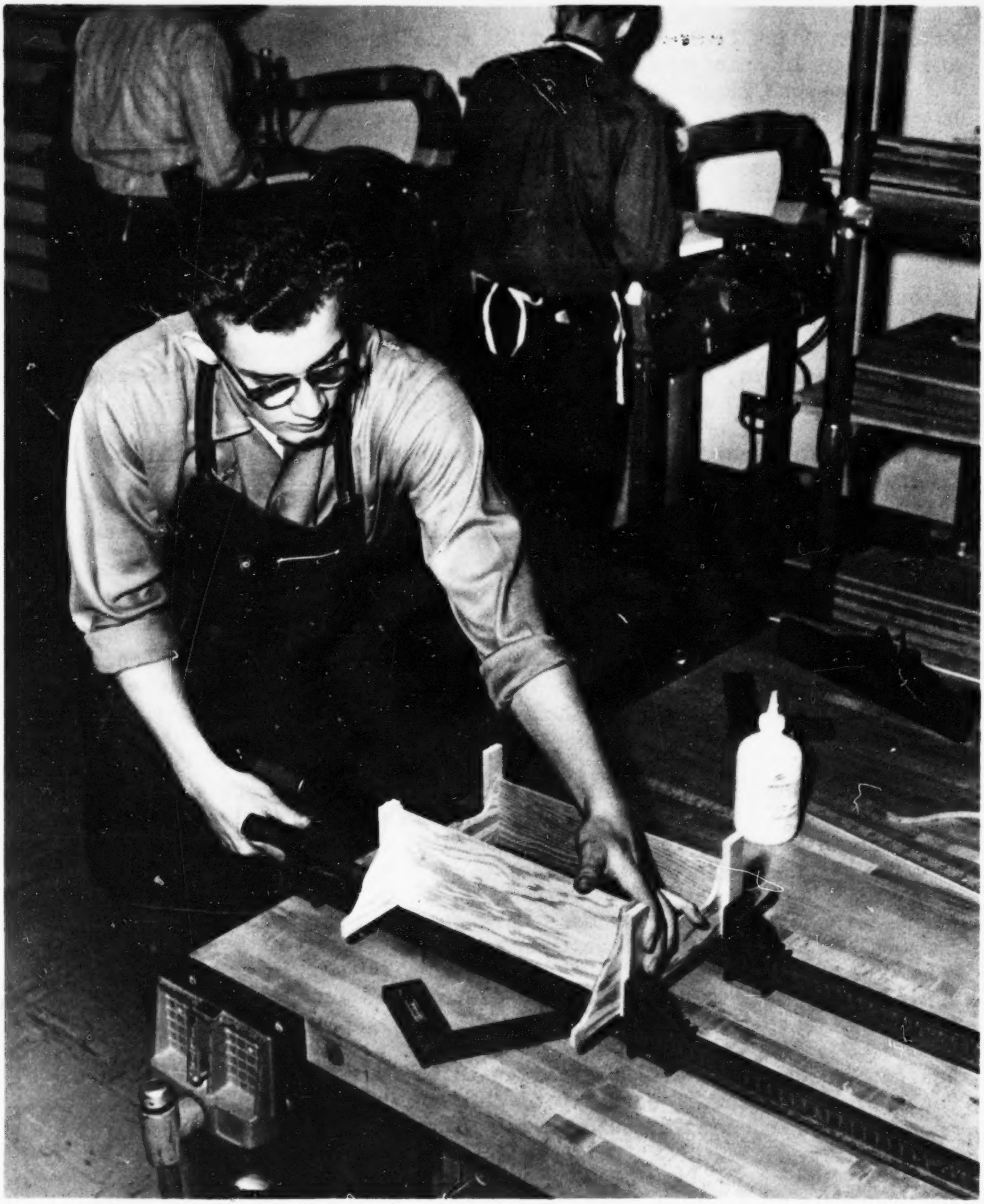
Alphabetize class names and make work station assignments and personal drawer or locker assignments.

Explain how tools are obtained and distributed according to the individual shop procedure.

Assign positions for class organization to facilitate ease of shop routine, as: clerk, foreman, tool checker, ventilation, clean-up, machine checker, and finishing area. (Organization depends upon the school.)

Discuss cabinet woods on hand in the shop, and recommended finishes for each.

Allow time for further project sleection.



Using Bar Clamps

Review drill and auger bit sizes and uses.

Review measurements and divisions of the inch.

Help with the sketching of a shop drawing of the selected project.

Demonstrate the use of the jointer explaining face jointing and edge jointing; emphasize adjustments and safety rules.

Check in last of shop equipment.

Show how to complete a "Bill of Materials" for project selected.

Discuss ways of cutting small pieces of wood for project parts checking for defects, color, and matching grain to avoid waste.

Check drawings and Bill of Materials.

UNIT II: HAND TOOLS

UNDERSTANDINGS

The student should:

- understand types of rules used in the wood shop
- know the several uses of the combination square (also called a machinist's set)
- study the steel rule and its division
- learn about the combination square for 90° and 45° angles and the level
- understand the use of the center square
- understand the use of the protractor for special angles
- develop the ability to use the protractor in layout work
- understand the testing of angles with level and plumb
- understand the location of center or cylinder ends
- develop the ability to measure depths

OUTLINE OF CONTENT

A. Special rules
   1. Folding rule
   2. Steel tape
   3. Zig-zag rule

B. Methods of measurement
   1. Inside size of an object
   2. Space between drawers of a desk
   3. Long distance, 12'-8"

C. Combination set
   1. Kinds
      a. Rule (or blade)
      b. Combination square
      c. Center square
      d. Protractor
   2. Uses
      a. Layout tool
      b. Testing angles
      c. Level and plumb
      d. Locating of center on cylinder ends
      e. Depth gauge
      f. Width gauge

SUGGESTED LEARNING EXPERIENCES

Demonstrate how to use a carpenter's folding rule and short stick to measure the inside width of a door frame. Call attention to its being handy for the carpenter to carry in his pocket compared to the one-piece, two-foot rule. Give reason for metal ends of rule. Warn about the breakage possibilities.

Demonstrate the use of the 6-ft. steel tape; measure the knee space between drawers of a desk. Show that one may measure around a barrel with this flexible rule. Tell the advantages over using a cloth tape line.

Show that the 6-ft. zig zag rule is used and is more accurate for measuring long surfaces than a 12-in. or 24-in. rule.

(References: 9, 12, 13, 16, 21, 23).

Show students the four parts to the set, explaining that sets may be purchased in small, medium, and large sizes. Show that the rule may be used as a straight edge for testing levelness of a surface and in straight line drawing for layout process. Call attention to the four divisions of the inch on the scale.

Demonstrate the combination square fastened to the rule to form a try square of 90° and 45° angles. Show that these may be used in layout and testing.

Demonstrate the center square fastened to the rule to locate the exact center on the end of a dowl or other cylinders.

Demonstrate the setting up of the protractor head to 22½°, or similar angle, lay this out on a piece of wood. Show that this tool may be used to layout on wood a project illustrated in a book.

Demonstrate that a table top can be tested for levelness by using the level bulb in the combination square. Also show that this may be used to test a window or door frame for plumb.

Demonstrate that when locating centers on cylinder ends, the rule must be kept tight to the end and the head tight to the cylinder.

Show that the rule, projected out from the 90° angle, may be inserted into a recess to measure its depth. Demonstrate that the rule projecting out on the 90° side may be used as a marking gauge.

(References: 9, 11, 12, 13, 16).

study how to use the combination square as a marking gauge

understand the purpose of the sliding T bevel

learn to identify the handle, blade, and thumbscrew

be able to set the tool to a specific angle

understand the use of the tool in laying out a project

learn how the tool can be used to test angles on wood

understand the use of dividers

distinguish between spring and wing dividers

be able to set and use dividers for drawing circles

be able to "step off" or divide a surface into equal spaces

know the uses of the marking gauge

learn the names of the four parts of this tool

know that older marking gauges were made of hardwood

D. Sliding T bevel

   1. Purpose
   2. Parts
   3. How set
   4. Use of T bevel
      a. Layout
      b. Test

E. Dividers

   1. Spring
   2. Wing
   3. Sizes
   4. Use of dividers
      a. Setting
      b. Circle drawing
      c. Dividing

F. Marking gauge

   1. Uses of marking gauge
      a. Setting
      b. Holding
      c. Gauging width
      d. Gauging of thickness
      e. Gauging of arc
   2. Parts
   3. Wooden
   4. Metal

Teach the class how the T bevel is used to both layout and test, and is intended for other than the 90° and 45° angles. Demonstrate how to unlock the blade and handle by means of the thumbscrew and then lock it.

Demonstrate how the T bevel may be set to 30° on a triangle and also by the use of a protractor. Demonstrate how this angle may be transferred onto a board.

Demonstrate on a precut piece of wood the use of the tool to test a given angle after it has been planed to the line.

(References: 9, 11, 12, 13, 16, 21).

Teach the class that dividers, similar to a compass, are used to draw arcs and to step off an area into equal spaces and that it may also be used to transfer space units from one object to another.

Explain that dividers are measured for purchasing.

Compare a wing divider to a spring divider. Demonstrate how each is set; the advantages of each type.

Set a divider to draw a 4-in. diameter circle and draw the circle on a piece of wood; stress not to punch the center into the wood and tilt the top a bit forward.

Set a divider at an inch and show how it is used to divide a piece of wood into several spaces that size.

(References: 9, 11, 12, 13, 16, 21).

Show the class how to mark a line parallel to an edge, using a marking gauge.

Teach the names of the four parts of the tool and advise that the face of the head has a brass insert to protect against wear. Call attention that the pin is to extend 1/8" below the beam and to be filed sharp.

Ordinary marking gauges are made of wood and a 6" rule is printed on the beam. Newer marking gauges are made of metal and have both a pin end and a sharp edge roller on the opposite end, the pin to be used on metal, the roller on wood.

know that newer marking gauges are made of metal

learn to set the marking gauge properly

learn to hold the marking gauge

learn to gauge for width

be able to gauge for thickness

learn about the special gauges and their uses

G. Special gauges

1. Butt
2. Mortising
3. Panel
4. Slitting

Demonstrate setting the gauge by loosening the set screw and sliding the head up or down on the shaft, stopping at the desired place on the rule, then locking it. Since the pin may become bent and affect accuracy, show the students how to recheck on the end of a rule to determine accuracy.

Demonstrate that the proper way to hold the tool is to grasp it in the hand as if to throw it, placing the thumb on the beam directly behind the pin, which should extend away from the thumb. The face of the head is to be kept tight against the good edge or face of the board, the pin tipped away from the woodworker, and the beam at right angles to the edge. Three or four light markings will produce a better job than one deep one. The board should be placed slanting against a support, such as a vise, while the fingers support the gauge from below at the top. Indicate that holding the board in the vise for edge and end marking is helpful.

Demonstrate on a precut board how the brass shoe on the head of the wood marking gauge may be used to mark along a curved edge.

Demonstrate how a butt hinge, having two pins, is used to lay out the gain on a door, explaining that this tool is confined to the carpenter trade.

Explain what a mortise is, then show how to set the mortise marking gauge and demonstrate how it is used, calling attention that one must be sure not to pull the tool beyond the end stopping lines. Good practice is to pull the pin from the end lines toward the middle of the joint.

Show a panel gauge, pointing out the long head that is to be slid along the edge of the panel and the long beam to reach across it. Demonstrate.

Display a slitting gauge and explain that it is meant for slitting thin soft woods instead of sawing and that the pin is actually sharp and similar to some pocket knife tips. Show how some soft pine or basswood about 3/16" may be slit, working on each surface.

(References: 9, 11, 12, 13, 16, 21, 33).

understand the use, composition, and care of the level	H. Level
	1. Use
learn to test for level and to read markings	2. Materials made
	3. Care
be able to test for plumb	I. Tube readings
	1. Level
know the different sizes available for purchase	2. Plumb
	J. Sizes available
know which tradesmen use the various tools and sizes of tools	K. Tradesmen
	L. Scrapers
know the uses of scrapers	1. Purpose
	2. Woods scraped
know the types of woods to be scraped	3. Kinds of scrapers
	a. Cabinet
learn the uses of cabinet scrapers	b. Hand c. Swan neck
	4. Sharpening of scrapers
learn the uses of hand scrapers	
	a. File b. Whet
learn the uses of swan neck scrapers	c. Turn burr
acquire skill in sharpening a scraper at 90° and 45°	
acquire skill in whetting a sharpened blade	
develop skill informing burrs on a blade	

Demonstrate the use of a level in checking a window sill for levelness.

Show how a 6' piece of wood, lying on a bench top, needs to be shimmed up on one end to become level.

Bodies of levels have customarily been made of a non-warping piece of wood. Newer ones are now made of aluminum or similar metal. Masons use the metal bodied ones almost entirely because wood picks ups moisture and warping.

Levels should be stored in a dry place and hung to avoid twist in the body. Care should be taken that the liquid tube is not broken by careless deposit of tools near level.

Demonstrate how the glass tube is made in a slight arc with the highest part in the middle so that the bubble inside rises to the top of the liquid. Show the two scratches on the tube and explain that an object is level when the bubble is exactly between them. By lifting either end of the level, note that the bubble slides toward the high end and anything along the base would be out of level.

Levels are made from 12" to 6' long; those most commonly used are 18" and 24". The long ones are usually used by masons. Tradesmen who use levels most often are the carpenter, stair builder, concrete form builder, machinist, and the mason.

Demonstrate the use of the tool and short bulb to test for plumb. Test a door frame for plumb, or a piece of wood 4' to 6' long held perpendicular on the bench top.

(References: 9, 21, 26).

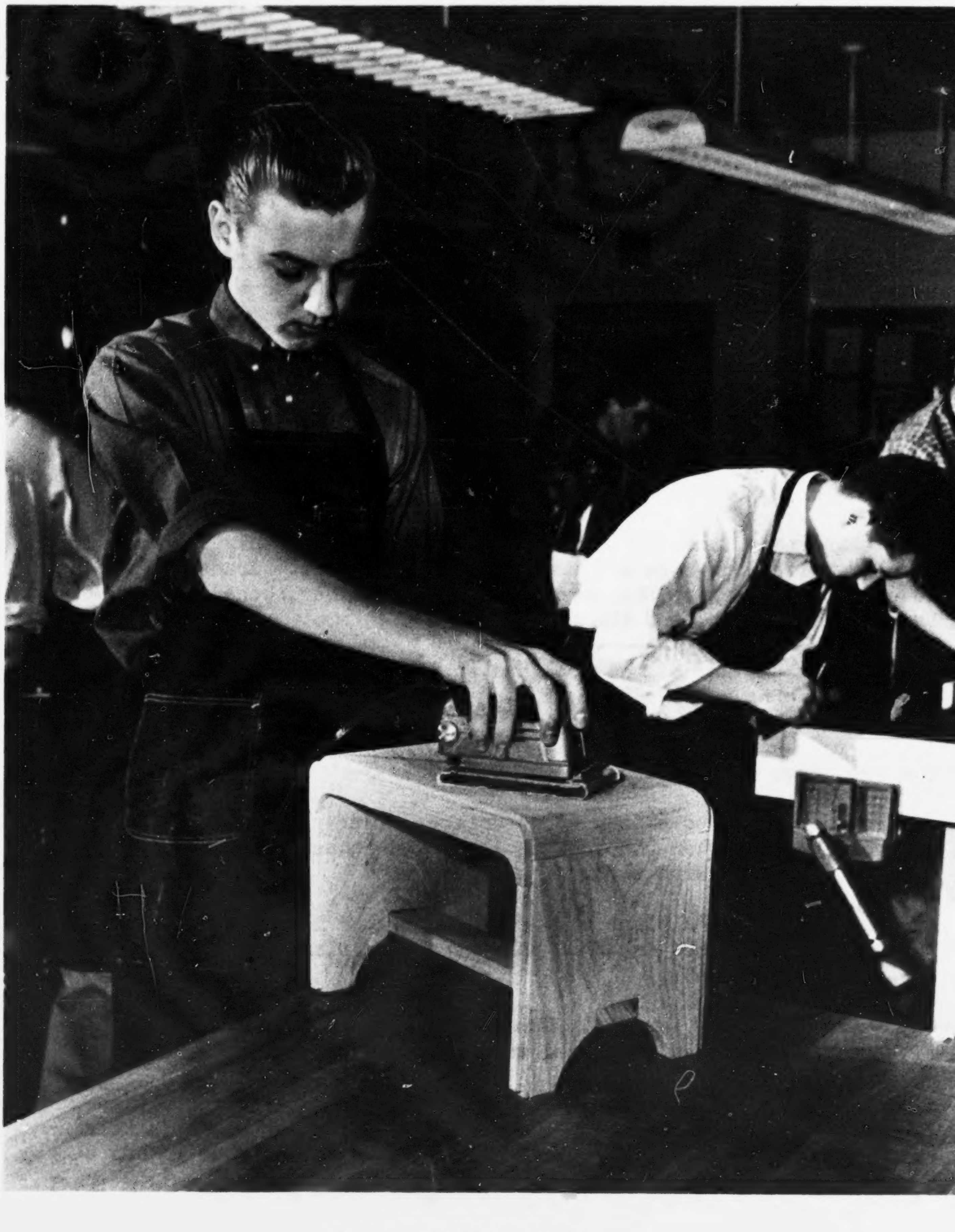
Scrapers are used to smooth wood surfaces after planing them and before sanding. When the tool is sharp and properly held shavings come off the wood with ease.

A scraper replaces a plane only if the operator is smoothing curley or cross-grained wood and then only because a plane blade would tear the wood out in spots.

Only hard woods are scraped. New wood is scraped; paints and varnishes must be removed first from used wood before scraping may be done.

Show how a cabinet scraper is similar to and different from a plane. The cabinet scraper has handles off each side and the blade is held forward instead of lying somewhat down as in a plane, thus it has a scraping effect.

Demonstrate how the fingers grasp both handles while the thumbs are placed down on the base behind the blade so that the tool with not "chatter" as it is pushed forward and possibly cause ripples on the surface. Demonstrate that the cabinet scraper should contact the



Using the Orbital Sander

surface to be scraped in a forward pushing motion, as an airplane coming down for a landing. Remind the class that dropping the tool to the wood, then pushing forward, causes "steps" to be made on the surface at the point of contact. Show that when finishing a stroke again the scraper should be gradually lifted from the wood to avoid a step at the end of the movement.

Demonstrate that the thumbscrew at the back of the tool makes a thicker or finer cut when turned.

Show that the scraper should be held at a slight angle.

Demonstrate planing a curly-grain board, then show that scraping it may be better.

Demonstrate the use of a hand scraper usually tilted 60° forward, thumbs behind, fingers along both edges, and pulled back slightly so that the corners will not dig grooves into the surface.

Show the class a swan neck scraper and a hand carved candy dish needing to be scraped, then demonstrate how this is done by scraping with the grain of wood, thus avoiding "tearing" when scraping against the grain.

Demonstrate sharpening the cabinet scraper blade with a double cut flat file, calling attention to the way angle filing is done and the fact that both lone edges are sharpened and used for scraping.

Demonstrate working both edges on the whetstone to remove burrs and obtain a smooth cut.

Demonstrate the way the edges are rolled slightly to produce a cutting edge, using a burnishing tool or screwdriver tip if a burnisher is not available.

Demonstrate sharpening the hand scraper blade with the file on both long edges, but point out that the angle is 90° to the faces instead of 45°. Show how to whet both long edges to remove the burrs. Show how a burr is rolled along both sides of each edge filed by using the burnisher, so that one will have four cutting edges instead of two on the hand scraper.

Explain that when the blade edges do not cut, the burnisher may be used to rub the metal edges back into place; and a new burr may be formed for more cutting. This may be done, however, only once or twice.

understand the uses of box scrapers	5. Special scrapers
	M. Slip stone
contrast newly designed wood scrapers	1. Uses
	2. Kinds
consider a substitute for a wood scraper	a. Natural b. Manufactured
know that slip stones are used to whet gauges and other irregular sharp edge tools	3. Shapers and pattern of slip stones a. Conical b. Flat faces, rounded edges
know that slip stones are made in sticks having triangular, flat, square, tapered, and many other shapes, for special work and come in coarse, medium or fine texture	c. Sticks 4. Degrees of hardness of slip stones a. Coarse b. Medium c. Fine

Advise the class that there are several especially designed scrapers, such as box and floor scrapers that a 12" or 16" dowel shaped handle and a special hand grasping device. With these, great pressure may be applied to wood.

Advise that newly designed wood scrapers may be purchased in paint and hardware stores. The blade of these scrapers is made of a special steel, pressed to a specified angle, and inserted into a paddle shaped wood handle. To sharpen these, only a file is needed.

Demonstrate that the convex curved edge of a broken piece of window glass may be used to scrape wood.

(References: 9, 11, 12, 13, 16, 21, 33).

Slip stones are used to put a keen edge on a tool that has been ground. It is also used to touch up a slightly dull tool where grinding is not necessary. Show the class a natural stone that has come from a quarry. Show the class a stone manufactured in an electric furnace. Inform the class that few slip stones now are natural stones.

Show the class a conical India slip stone pointing out the tapered convex and concave surfaces, the tapered rounded edges, and the flat surface at the base. Explain that this stone will be suitable for nearly any sharpening job in the shop.

Show a slip stone with two flat surfaces, one with a small diameter rounded edge, and the other with a larger diameter opposite the smaller one. Point out the limitations this stone has for gauges.

Demonstrate using each stone on a gauge, showing how to keep the stone flat against the straight surface of the tool.

Show how to remove steel chips from slip stone with thin oil and a cloth.

Show that the slip stone is moved, instead of the tool, when sharpening.

Remind the class that the stone will break if it is dropped.

There are a number of other shaped slip stones made for special purposes: slim tapered cones, cylinders, squares, triangles, and ovals.

One may purchase a coarse, medium, or fine texture stone in several sizes.

(References: 9).

know that burnishers are used for rolling or smoothing metals and that the body of the burnisher is oval and tapered at the top.

N. Burnisher

1. Purpose
2. Shape
3. Steel used
4. Angle burnishing
5. Substitute tool for burnishing

Display a burnisher and explain its function. Call attention to the oval shape of the body, and to the tip tapered to a point for approximately one inch. Point out that the steel has a smooth polished surface so that it will slide over other metals with ease. Demonstrate burnishing a burr on a hand scraper.

Show how to grasp the body of the burnisher with the finers of one hand, palm up, and with the knuckles of the hand sliding along the face of the scraper. Grasp the wood handle of the scraper with the other hand, holding it level; and while exerting down pressure, pull the burnisher toward yourself quickly. This operation should be repeated several times.

The tip of an ordinary screwdriver may be substituted for a burnisher. Use it in the same manner as the burnisher; demonstrate.

(References: 9).

UNIT III: POWER TOOLS AND MACHINES

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Portable electric drill
learn the versatility of the portable electric drill in regard to materials and attachments	1. Portable electric drills in general a. Uses b. Sizes c. Parts
be able to use the electric drill for drilling, buffing, and stirring	d. Operation 2. Attachments a. Bench holder b. Grinding wheels c. Buffers d. Wire brushes e. Saw blade f. Paint mixer g. Sanding attachments 3. Safety a. Starting b. Handling c. Wet areas d. Special attachments e. Design devices f. Grounded plugs

SUGGESTED LEARNING EXPERIENCES

Demonstrate for the students the method of using the portable electric drill. Drill holes for screws in cabinets under construction and call attention to the usefulness of this machine.

Discuss the varied uses of this machine and attachments in connection with wood, metal, plastics, and other materials.

Explain that several sizes of these machines are manufactured to take care of the range in needs from small shop to heavy manufacturing, and that the sizes are designated as 1/4 H.P., 1/3 H.P., 1/2 H.P. and 2/3 H.P. Also explain chuck sizes vary with the horse power and are available in 1/4", 3/8" and 1/2" sizes.

Demonstrate that a twist drill may be locked in the chuck by means of the chuck key; call attention to the fact that the chuck is connected directly to the motor shaft as the source of power. Explain that the housing protects the motor.

Show that the switch is in the form of a trigger, and that it has to be tripped to start or stop the machine.

Remind the students that when drilling small holes with a twist drill one has to pay attention to holding the machine at a right angle to the object being drilled since there is no guide on the machine. Explain that when using twist drills the same rules are followed as when using hand tools to avoid drill breakage.

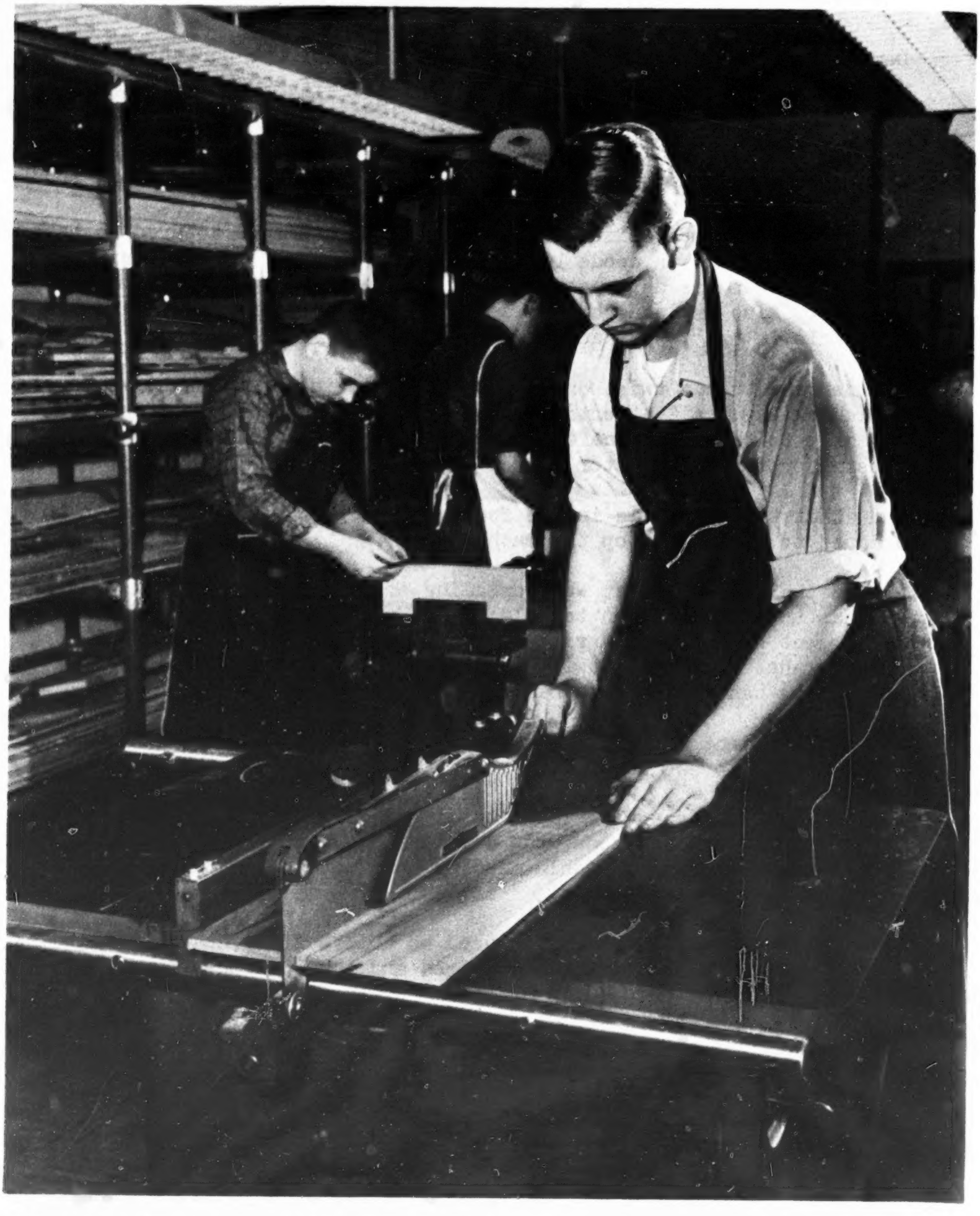
Show the student how the bench holder for this electric drill enables the operator to use both hands to manipulate the materials.

Demonstrate that be fastening a small grinding wheel into the electric drill by means of an arbor, the machine may be converted into a grinder, and used either as a portable machine, or fastened into the bench holder for sharpening tools.

Show that the same arbor may be used to hold buffing heads so that furniture and other items may be waxed and then polished by using the electric drill.

Demonstrate that the drill may be locked in the bench holder, and that the buffer can be used to polish furniture hardware at a bench instead of on the furniture where the varnish may be harmed.

Demonstrate the use of wire brushes in the electric drill for removing peeling or scaling paint from an object or for removing rust from machines or tools by using the machine either as a portable unit or locked into the holder.



Ripping a Board on the Circular Saw

Show the class how a hole saw may be used with this machine.

Show how a paint mixer can be made by bending a stiff piece of wire so that it has a triangular base and a straight shaft. Lock this in the chuck and mix a can of paint with the electric drill. Caution - be sure to have a cardboard cover over the paint can when doing this.

Demonstrate making a disc sander with the electric drill fastened in the bench holder.

Explain that there is a vibrating sander that is operated by the electric drill and flexible cable, but is not in much general use.

Safety suggestions for the class:

1. Be sure the starting switch is in the off position when plugging the machine into an electrical circuit.
2. Avoid dropping the machine because the shaft may become bent.
3. Never stand on a damp or wet floor when using the electric drill.
4. Exercise care in handling attachments since there are few safety devices that go with them.
5. Grounded three prong plugs are safer than the conventional two prong plugs.

(References: 11, 12, 26, 34).

know that there are several types of automatic lathes in industrial use

recognize the names and know uses of special chisels used with the lathe

learn to set and use outside and inside caliphers

B. Wood lathe

1. Types and parts

    a. Hand machine
    b. Automatic machine
    c. Parts of lathe

2. Lathe tools

    a. Chisels
    b. Calipers

        (1) Outside
        (2) Inside

    c. Dividers
    d. Slip stone

Show the students how the wood lathe is started and stopped, and display samples of spindle and face plate work.

Mention that the school shop lathe operator works free hand, producing projects, while in industry most lathe work is done on an automatic cutting machine capable of producing a finished turning in minutes.

Mention the names of a few important parts of the machine and in a few words tell the function of each, such as live and dead centers, headstock assembly, tailstock assembly, bed or ways, and tool post and rest.

Show a few of the basic wood turning chisels, such as a gauge, skew, parting tool, square-nose scraper, round-nose scraper, and diamond-point scraper, and mention that there are additional tools for the professional turner to suit each worker.

Demonstrate quickly how each tool cuts a revolving piece of wood.

Display an outside caliper, set it with one leg on the end of a rule; then demonstrate its use to measure diameters on turnings. Caution students about forcing the tool over the wood; set it slightly oversize to allow for sandpapering.

Do the same as above with an inside caliper; caution students that the power must be turned off when using the caliper as a measuring device, because the revolving project might throw the tool.

Show how dividers are used to mark distances along a spindle turning and on the face of faceplate turnings. Demonstrate that dividers are set either by using a rule or by picking the distance off a full size template or layout.

Demonstrate that gauges and other lathe tools are kept sharp by touching up the edges of a few tools on a slip stone. Remind students that the stone will break if dropped. The surface should be kept free of steel particles by wiping the surfaces occasionally with a cloth saturated with thin oil or kerosene.

Show the student a piece of 2" x 2" wood mounted in the lathe, ready for turning. Explain that if the wood were 3" x 3", or larger, some of the corners would have to be removed with a saw or plane before turning on the power.

Explain the necessity of having all lathe stock oversize so that when the project is turned to shape and size it will be true and round. Point out that the grain should be reasonably clear, straight, and running the long way of the wood.

understand that spindle turnings are produced between the centers and that the wood grain runs the length of the project

learn to locate the centers on each end of the wood stock

understand that one end of the wood stock is sawed to make room for the live center spurs

be able to mount the center and stock into the lathe and fasten the dead center to it, oiling the dead center and wood at the same time

know that the tool rest is fastened near the wood preparatory to turning

know the proper tools and techniques necessary to turn stock from square to rough round

be able to "size" the wood with a part tool and to turn the rough round to the finished size with the skew

learn to trim ends and lay out the design, using the proper tools

be able to sand a completed project, and to apply a finish while the project is on the lathe

3. Spindle turning

   a. Preparation of stock

      (1) Marking of ends
      (2) Drilling of ends
      (3) Sawing of one end
      (4) Driving line center
      (5) Mounting and oiling

   b. Tool rest adjustment
   c. Rough turning
   d. Sizing with parting tool
   e. Turning to size
   f. Trimming ends and layout design
   g. Cutting of design
   h. Sanding of object
   i. Application of finish

Demonstrate on the ends of a square piece of wood (2" x 2"), how the center is located by connecting corners. Describe on paper or chalk board the method of finding the center of an irregular end by the use of dividers.

Explain reason for drilling both ends a short distance at the intersection of the lines. Indicate what size drill to select. Mention that this process is important when using hardwoods, but thus when soft woods are used a divider tip or nail pressed into the wood is sufficient.

Demonstrate how only one end is to be sawed to make room for the live center spurs, and call attention to the depth of the cut.

Demonstrate how a live center is driven into the end sawed, explaining that a carpenter's hammer is not to be used for this operation. Explain why this pounding should not be done on the bed, or ways, of the lathe.

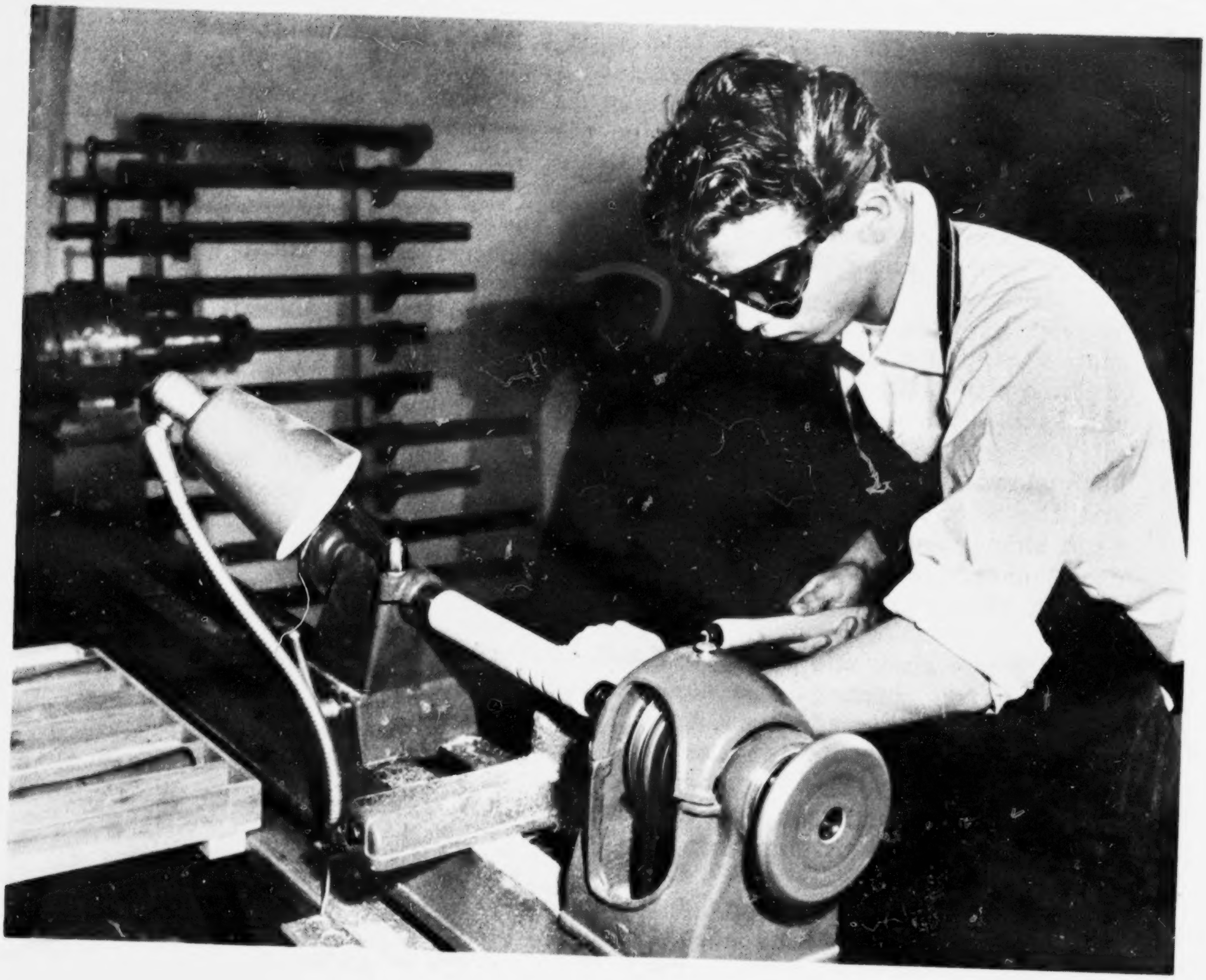
Demonstrate how the live center is inserted into the lathe spindle and the wood brought up to it so that the spurs fit into the dents made when pounding the spur into the end of the stock. Show how the dead center is brought up and fastened to the right end of the stock, oiling it at the same time, then locking the quill.

Demonstrate that the tool post and tool rest are brought up and into position for turning. Be sure to call attention to having them no farther away from the work than 1/8" when starting, and that it is important to keep moving the tool rest periodically when the distance from the wood to the rest becomes greater than 3/8". Explain that this part of the machine may be adjusted eight different ways to take care of all requirements of turning.

Explain that when starting spindle turning, the rest is to be slightly below the center of the stock. It may be raised or lowered after the cylinder is formed to accommodate the shapes of the rest of the tools.

Demonstrate that the stock in the lathe may be turned into a cylinder. Show that the stock is turned over by hand first to see that no corners will strike the tool post. Show that the larger gauge should be grasped first, using both hands. Show that the tool is brought to the tool rest first, then advanced to the wood to cut. Show that the square stock is run at low speed until it becomes almost a round. Advance the tool rest as needed to keep the space between it and the work small to avoid trouble.

Be sure to show that the handle of the gauge should be several inches below the cutting edge and behind the cutting edge for producing a smooth cut. The wood should be cut from the middle toward each end. NEVER from the end to the middle. Explain what might happen if cutting is started at an end.



Spindle Turning on the Lathe

Stress that it is necessary to stop the machine to examine the turning to see if it has flat surfaces still on it. NEVER feel the revolving wood with the fingers to determine this, because injury to a finger could result.

Show the use of the parting tool to "size" the cylinder a bit over size, and to test with the caliper.

Demonstrate holding the skew to take a shearing cut off and arrive at the desired diameter.

Demonstrate that the end of the project is placed on the cylinder, about an inch from the live center, with the parting tool, and that the described length is marked on the cylinder with rule or dividers near the dead center and cut with the parting tool.

Show how the design of the plans is transferred to the cylinder and how the tools are used to cut the beds, "V" cuts, and concave and convex surfaces.

Demonstrate how to sand the finished product and discuss what grades of sandpaper are used for each stage of the work. As a safety factor, call attention to having to remove the tool rest before sanding. Show how to fold the paper before sanding flat surfaces and how to roll it like a pencil for convex surfaces. Show that by pressing a piece of sanded hardwood against the revolving cylinder, a super-smooth surface is secured since the fibers have ironed down to a glossy finish.

Demonstrate that the completed project may be stained shellacked, or varnished in the lathe, or how a French polish may be put on by using oil and shellac.

Point out the importance of placing a splash panel behind the lathe to avoid splashing finishing materials against the wall.

Tell the class that turned work may also have finish applied at the finishing bench instead of in the lathe.

recognize a face plate and know its use in connection with wood turning

know that stock needs to have right angle corners removed before it is turned

learn the method of fastening stock to the face plate and the method of using chisels to true stock to the desired size

understand that a piece of wood should be fastened to the face plate as back up

be able to use glue and paper to fasten the project wood to the back up piece

learn to remove a completed project from the back up wood

know that some objects are face turned and then completed on the reverse side by inserting in a wood chuck

understand how a chuck may be made as an inside chuck

4. Face plate turning

   a. Preparation of stock
   b. Cutting to circle
   c. Fastening to face plate
   d. Turning to circle
   e. Turning to thickness and design
   f. Sanding
   g. Finishing

5. Chuck turning

   a. Inside
   b. Outside

Show the class a face plate and demonstrate fastening it to the spindle of the lathe. Indicate that a lead or leather washer placed behind it will allow it to be removed easier when the work is completed.

Point out that the wood fastened to the face plate needs to be planed perfectly straight and smooth before it is fastened in place and that it is best to cut the wood to a circle, or at least to an octagon; either way it should be a bit oversize.

Discuss the selection of the proper flat head wood screws, and demonstrate fastening the wood to the plate. MAKE SURE THE SCREWS ARE TIGHTENED.

Demonstrate setting the tool rest so that the edge may be turned to a cylinder and show that the round nose scraper is held to do the turning. Explain that it is best to turn from each face to the middle of the edge. Doing this operation in reverse has a tendency to push the surface fibers away from the wood, resulting in surface chipping.

Demonstrate that the face is leveled with the round-nose scraper and finished with the square-nose scraper and the testing of levelness. Demonstrate cutting a design in the wood which might be used for a lamp base.

Show that this completed turning may be sanded and that finish may be applied in the lathe or the finishing table.

Demonstrate how project wood is glued to another piece of scrap wood that has been fastened to the face plate and turned round and true. Show that the hand screws are used for pressure and that pieces of Kraft paper are used between the good wood and the scrap piece. Explain why paper is used.

Turn a small project, apply finish, and show how the project is removed from the scrap wood by using a chisel.

Demonstrate how simple chuck turning is done, by making a partly turned bowl that has been screwed directly onto a face plate.

Show how a chuck is made from a piece of wood screwed to a face plate and explain that friction from a force fit will hold the bowl in the chuck. Turn the recess in the bottom of the bowl and sand it. Demonstrate one of several ways the completed bowl may be removed from the chuck.

be able to turn a round leg, having a square end	6. Turning of round leg, square end
know what a split running is and where it is used	7. Split turning
	8. Accessories for lathe
know that there is a floor rest for large turnings	a. Special face plates b. Special tool rests c. Floor rest d. Arbor
know that there is an arbor that will hold a buffer, grinding wheel, sanding disc, wire brush	(1) Buffer (2) Grinding wheel (3) Sanding disc (4) Wire brush

Demonstrate the turning of a leg so that it is round, with a square end a few inches long for fastening to a table rail. Explain that it is necessary to fasten it in the lathe accurately, then mark the end of the square around the stock with try-square and pencil. Caution that the lathe is started at very slow speed and show tha the inverted skew tip is slowly pushed into the revolving corners so that the fibers will not become chipped. Show that a second cut about 1/8" away from the first one, and over what will be the round part, is cut next so that the original cutting may be made deeper. Then complete the round turning as in any ordinary spindle work. Caution the class that square corners are dangerous as they revolve, that loose clothing may be caught, or that fingers may be scraped by the revolving corners.

Demonstrate that a split turning to be separated later, may be made by gluing two pieces of stock together with paper between them. For safety a wood screw should be placed near each end in the waste area.

Explain that accuracy of locating the centers is of great importance to insure a complete half turning.

Spindle turn the glued stock and sand; then split apart in the same way as splitting work fro the face plate. Explain that such work might be used for flat surface decorations on chests or doors.

Examine face plates of different diameters and explain where each might be used. Show one face plate with a screw center and demonstrate fastening the wood to it.

Demonstrate a tool rest made at a right angle, and used for turning inside a bowl. Also make a long one that needs two tool part holders to hold it. Explain that it is easier to turn such things as baseball bats with such a rest.

Demonstrate that a table top or lazy susan 18" or 20" in diameter is too large for the "swing" of the lathe and that for objects of this size the face plate needs to be fastened to the left end of the spindle or on the outside of the machine.

Demonstrate the use of the floor rest to hold the tool rest when doing large turnings. Caution that excess speed may break the glued paper joint apart and that slower speeds are required since the foot speed is much greater with larger diameter objects.

Show the class an arbor that may be inserted into the spindle so that the machine may be used as a buffer, grinder, or sander, and for use with a wire brush.

know the safe distance for a tool rest from revolving stock

be cautioned that loose clothing might become wound up in the moving machine

know that it is dangerous to feel the revolving turning with the fingers and that the tool rest is to be removed before sanding is done

understand the purpose of the machine and know that there are permanent and portable machines

understand the uses of disc, belt, and orbital action sanders

learn the proper pressure and techniques for sanding flat surfaces and edges

be able to sand end grains with and without guides

be able to use the correct methods of sanding convex and oo concave surfaces freehand and with jigs or guides

10. Safety procedures on lathe
    a. Clothes
    b. Eyes
    c. Fingers
    d. Sanding
    e. Tool rest

C. Sander

1. Kinds of sander
    a. Machine
    b. Hand

2. Parts of the sander
    a. Frame
    b. Motor
    c. Fan
    d. Disc or pulley

3. Methods of using sander
    a. Face surface
    b. Edge
    c. End
    d. Curved
    e. Painted
    f. Fastening abrasive

Point out that it is very important to keep the tool rest close to the wood being turned so that nothing may get between the wood and the rest; a distance of over 3/8" is considered unsafe.

Long sleeves, ties, and apron ties are dangerous around this machine. Fingers should NEVER BE PLACED ON REVOLVING WOOD unless one is sanding.

Demonstrate that flat surfaces may be detected while the wood is in motion by placing the middle of the turning tool on top of the wood.

Demonstrate that the tool rest should be pulled several inches away from the completed turning before sanding is started or removed entirely.

(References: 9, 11, 12, 16, 19, 20, 23, 25, 30, 34).

Show the class how to start each sander in the room and sand a surface, calling attention to permanent machines fastened to the floor or bench, and to portable models.

Demonstrate and explain the advantages and disadvantages of the disc, belt, and orbital machines.

Identify by name and explain the function of: the frame, motor, fan, shoe, and disc or pulleys according to each machine's construction.

Demonstrate that only slight pressure is needed when holding work against a permanently installed belt or disc sander.

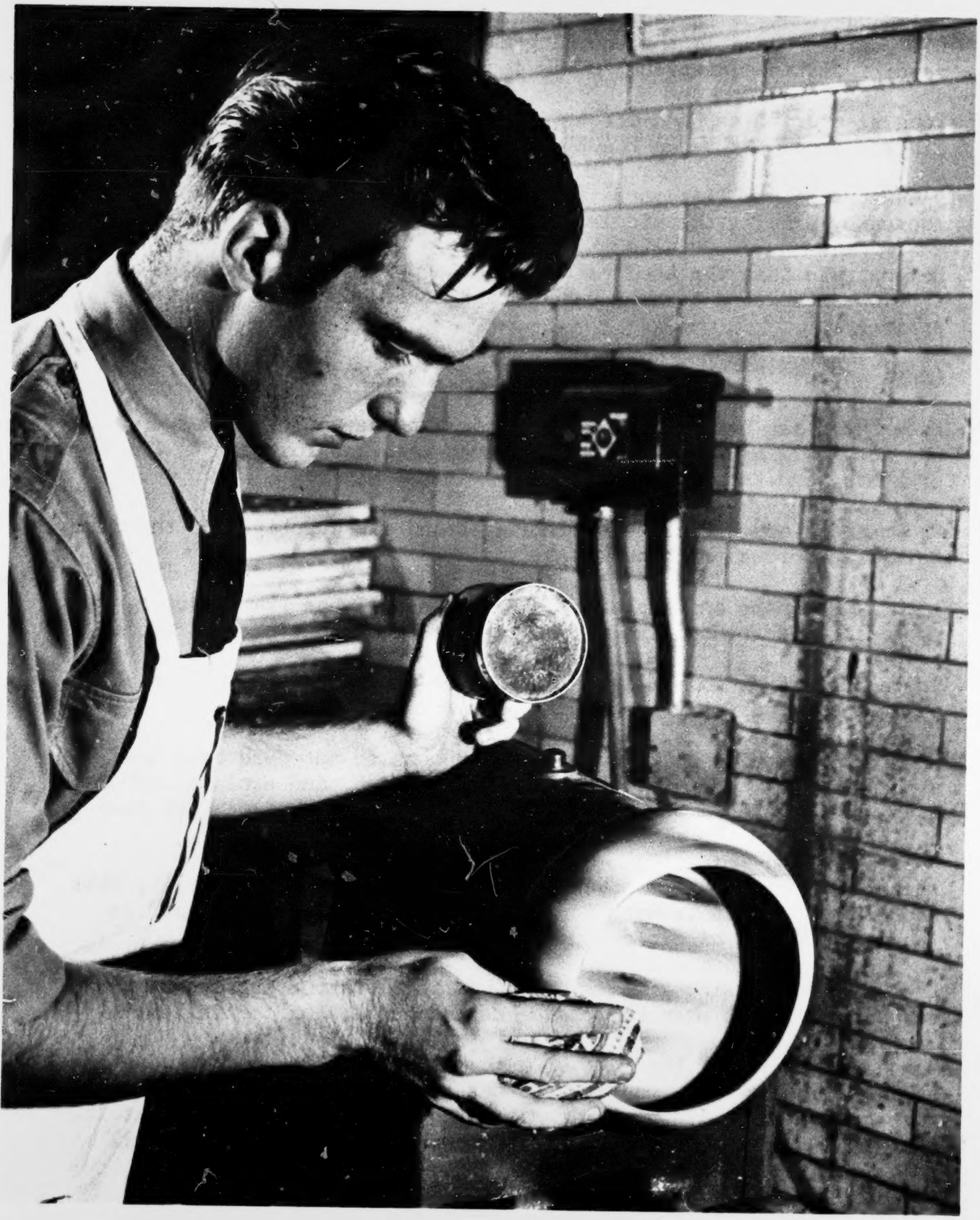
Show that portable belt and orbital sanders do not need pressure applied, since their weight will be sufficient, and explain that too much pressure has a tendency to clog the sanding surface with dust and resins from the wood.

Tell that "open coat" sandpaper is made to overcome, partially, this trouble. It is to be used for softwood while the "close coat" is made to use with hardwood.

Demonstrate by using a whisk broom how to clean the surface of the sandpaper of dust when the paper has become "loaded" or filled.

Demonstrate sanding the face of a board with a belt sander. Caution students to lower it gradually to the surface, heel first, with a forward motion, as when planing a surface, to avoid "biting" out low spots. Remind them not to tip the machine sideways for this will gouge grooves in the area being sanded.

Remind the class that when using either the belt or orbital machine it is important to avoid low spots by keeping the machine constantly in motion over the whole area: forward, backward, and to both sides.



Finishing a Bowl

Demonstrate sanding an edge using the permanent and portable machines, and point out that the table of the disc sander may be adjusted approximately 10° and down 45° so that one may sand chamers or bevels on edges if needed.

Show that end grain may be sanded on a permanent sander by using the miter gauge to assure keeping a true right angle on the end. Clamp two short pieces of 3/4" thick wood even with the end of the piece to be sanded so the edges will remain sharp and square.

Indicate that disc sanding on any surface leaves arc scratches and is not desirable if the surface is later to be stained and varnished, but will do if it is to be covered by opaque finishes such as paint.

Demonstrate how convex edges may be sanded on the disc sander by placing the wood flat on the table and rotating the curved surface fairly fast against the sandpaper.

Show how a belt sander will do a better job since it does not leave scratch arcs on the finished surface. A holding table or rack can easily be made to hold the portable belt sander for this work and it can be steadied by locking it in a bench vise.

Demonstrate that convex arcs on edges may be sanded by fastening a sandpaper strip to a cylinder that has been turned to correct size and mounted in a wood lathe. Fasten a piece of wood on the lathe for guiding work. Have the sanding cylinder pass through this brace and at right angles to the sanding surface. Sand the concave wood surface by lightly pressing it against the wood jig or guide and the sandpaper. By keeping the work against the clamped wood form, a good right angle will be maintained. Sanding may be done without the back guide but care must be exercised to keep a right angle.

Show method of turning a similar cylinder, mounted with a sheet of sandpaper. By adding an arbor the cylinder may be placed in the drill press for sanding, thus achieving the same results. A piece of wood with a hole a little larger than the sanding cylinder should be fastened to the drill press table before using.

Inform the students that sanding painted surfaces is very hard on the sandpaper and that the paint should be removed first and then the surface sanded.

Show students several kinds of abrasive sheets and belts that may be purchased and explain the difference between natural and manufactured grit. Display "open coat" and "closed coat" sheets. Show paper-backed and cloth-backed abrasives and discuss the difference.

Demonstrate placing the belt of abrasive on a belt sander and show how the adjustments operate so that the belt will not run off.

know the different abrasives obtainable and the methods of fastening them to each type of machine

understand safety and health factors in the use and operation of the machines used in this work

4. Other machines fitted to do sanding
   a. Lathe
   b. Drill press
   c. Shaper
   d. Circular saw

5. Accessories for sanders
   a. Bag
   b. Pads
   c Guides
   d. Table

Demonstrate removing a worn sheet of sandpaper from a disc sander and cleaning the metal disc while it is in motion by scraping it with the tip of an old file.

Explain that by pressing a piece of end grain wood to the cleaned surface the friction will warm the disc so that the cement or adhesive will metl and stick easier to the disc.

"Charge" the warm disc with a stick of adhesive moving it slowly from edge to center so that friction heat will melt it.

Demonstrate that the sanding disc, pre-cut from sandpaper purchased by the yard, is then pressed with the fingers onto the charged disc. Show students how to press it still tighter by sanding some scrap wood and how to trim any protruding edges to the correct size by scraping with a file while the machine is in motion.

Explain how the wood disc on the wood lathe, that had been leveled and turned to true round, can have a sheet of sandpaper glued to it by using a pressure caul and three clamps. Point out that the excess corners may be trimmed off when the glue has dried and the caul has been removed.

Demonstrate the method of replacing sandpaper on a cylinder from the lathe or drill press. Have the old wedge loosened and a new one ready to insert.

Describe what a split turning is and how it can be made to hold the sandpaper without using a wedge. Also describe how abrasive crystals may be sprinkled on a glue covered surface when when dry, yields a temporary sanding surface.

Advise students that special guides, or jigs, can be made to simplify the sanding process and do production sanding, such as chamfers and rounding edges. A jig may also be made to hold a portable belt sander on its side in order to sand edges, ends, and arcs.

Explain that, for delicate sanding of edges, the jigsaw can be converted into a cylinder type of sander and that the grinder and circular saw can be made into a disc sander by attaching a flat piece of plywood with sandpaper glued to it. The shaper or router may likewise, with a bit of ingenuity, be modified to do sanding.

Discuss safety and health considerations, such as:

1. Keep portable sander lying on the side so that when the cord is plugged in the machine will not start up and run wild if the switch has been carelessly left in the "on" position by the last operator.

recognize the two basic types of table saws and the general differences between them

know the difference between a rip saw and a crosscut saw blade, and know how to use each correctly

know the difference between a combination utility saw and the rip and crosscut, and compare cuts made by each

understand use, construction, and tooth style of the hollow ground saw

learn the uses of the dado set, and the sizes of the different parts

D. Table saw

    1. Table saw
        a. Utility
        b. Universal
    2. Blades and attachments
        a. Crosscut
        b. Rip
        c. Combination
        d. Hollow ground
        e. Dado set

2. Have work to be sanded, fastened in some manner so that it will not be in motion when sanding.

3. On disc sanders, sand on the part of the disc that is turning toward the table.

4. With all types of sanders be sure to keep the fingers back slightly, especially since safety guards are difficult to place on this type of machine.

5. Have ties tucked in shirts, apron bibs, and sleeves either buttoned or rolled up to the elbows.

6. Dust collectors of some sort should be installed on each machine wherever practical.

(References: 11, 12, 20, 30, 34).

Mention the name of the type of power saw in the shop and show how the saw blade may be raised and lowered. Demonstrate that the saw arbor (or table as may be) may be tilted to saw other than a 90° angle, and that the angle may be read on the indicator scale. Demonstrate how the saw is returned to cut a perfect 90° angle for general use again.

Show crosscut and rip saw blades, them demonstrate the use of each for sawing boards. Compare the cuts and the time needed for each cut. Mention that a rip saw used as a crosscut may kick the wood back when wider boards are being sawed. Call attention to the saw "set" on the teeth. Compare the combination saw blade teeth with those of the rip and crosscut saws, then demonstrate ripping and crosscutting with the combination saw and compare the sawed surfaces with those cut previously.

Show the hollow ground saw teeth and, with a steel rule, show that the mid-portion of the blade is lower, or thinner, than the center and outside. Explain that there is no set to the teeth and the hollow grind makes the clearance. Explain that the hollow ground saw is used for fine cutting and produces a planed effect along the edges, free of sawtooth scratches.

Demonstrate cutting a strip of molding for a picture frame with the hollow ground saw and show the smooth finish cut obtained.

Demonstrate that a dado set may be placed on the arbor and a cut may be made by one pass so that a panel will fit into the groove. Teach the various components that go to make a dado set. Show that the raker parts are staggered between the outside saws. Explain how different widths may be cut by using different raker combinations.

be shown the fence and the way that it is set

understand the uses of the miter gauge and how wood may be cut other than at a 90° angle

understand what the splitter is and under what conditions it is necessary to use it

know what the saw guard is, and how it may be installed to protect the operator

know what a feather board is and under what conditions it is necessary to attach it to the saw table

understand how a taper jig may be made to assist in cutting tapers

3. Attachments

    a. Fence
    b. Miter gauge
    c. Splitter
    d. Saw guard
    e. Feather boards
    f. Taper attachment

Demonstrate that the fence may be moved from left to right to cut boards to different widths. Show how the fence is locked, and in some cases how it is tilted to make an angle cut other than 90°. Show that the exact measurement may be secured using the micromeasurement attachment that is a part of some fence equipment. Rip a few short boards to show how one needs a narrow stick pusher to push them through the saw while those 6" and wider are pushed with only the right hand.

Attach the splitter and demonstrate how it keeps long boards from closing the kerf behind the saw to avoid kick back. Mention that "green lumber" is more apt to kick-back than kiln dried.

Demonstrate the use of the miter gauge to cut off ends of boards and to cut them to the proper lengths.

Show that a piece of 1" x 2" wood screwed to the gauge on the saw side will help make a better cut since the fibers on the back side of the piece are reinforced by this added strip and will not chip as the saw passes through.

Show that a stop block may be clamped on the fence, or strip, so that a number of pieces may be cut the same length.

Show that the miter gauge may be adjusted to cut ends to 30° and 45°, both right and left.

Demonstrate that a number of short pieces may be cut from long strips by clamping a steel block onto the fence to allow clearance after the piece has been cut. Explain that this will avoid the dangerous kickback of the wood. If the steel block furnished with the saw is not in the shop, a small square of wood may be clamped to the fence in its place.

Demonstrate the installation and use of the saw safety device. Inform the students that it should be in place when the saw is in use.

Suggest that when the furnished guard is available a block of wood should be clamped over the saw area to protect fingers from cuts.

Demonstrate the proper position to take when using the saw and the safe way to place hands on the wood being cut.

Show how narrow staock is held tight to the fence by using a small piece of wood so that the fingers are kept a safe distance from the revolving saw.

Explain the purpose of a feather board and demonstrate the making of one. Show how to fasten the feather board to the saw table to hold the stock gight to the fence while ripping a number of pieces all the same width. Point out how this device is a "finger saver."

learn the proper place to stand and to place hands and fingers while ripping and crosscutting boards

know the proper way to handle plywood and solid panels on the table saw, how to set the saw, and to cut grooves for panels in wood

learn how to make a rabbet in a board and how a dado may be cut

understand how 45° angles may be cut for picture frames, and on edges and ends of wood stock

know how tennon joints may be sawed on the table saw and know the importance of using the guards

4. Stance (foot and hand)

    a. Ripping
    b. Crosscut
    c. Plywood and panels

5. Joints

    a. Groove
    b. Rabbet
    c. Dado
    d. Angles other than 90°
    e. Tennons

Demonstrate how a taper jig may be made and that it cuts tapers of different sizes, depending upon set of the jig.

Show the students that while ripping stock, it is most convenient to stand directly behind the left table of the saw because most pushing is done with the right arm. In the position described the right arm is in direct line with the saw blade.

Show that when crosscutting, the natural position is to stand directly behind the saw because the miter gauge is generally pushed with the left hand.

Remind students that only on rare occasions does the operator stand on the side of the saw table to operate the saw.

Demonstrate cutting a piece from a 4' x 4' plywood panel by reversing the miter gauge, then placing the panel against the gauge and pushing the panel through the saw, supporting the panel from the rear.

Show that, when use of the fence is impossible, a straight edge may be clamped to a plywood panel in order to cut off a piece. Call attention to the importance of keeping the straight edge tight to the edge of the saw table when pusing the panel through.

Demonstrate that a 1/4" groove near the edge of a board can be cut with the table saw. Set saw for correct depth, and fence for specific distance. Show how to place the saw cut for the opposite side of the groove, and then how to remove the center stock by making successive cuts until the groove is clean. Show that, by using two 1/8" thick dado blades, the groove may be made in one pass.

Demonstrate that a rabbet joint may be cut along an edge of a board by holding the edge against the fence, and that the second cut is made by holding the face to the fence. Explain also that this joint might be made by using a dado head.

Instruct the class when to measure from the right side of the saw blade or from the left side so that the rabbet, when completed, will not be too wide.

Demonstrate that a dado may be cut across a board so that another board will fit into it, as in making a shelf fit into the side of a book case. Set up a dado head to match the size of the second board, then make the cut. Show that when only one such cut is to be produced it would be timesaving to make serveral passes over the crosscut saw instead of setting up the dado head. Demonstrate how to cut a stop dado by clamping blocks to the table.

understand the necessity of using pushers when ripping narrow stock

understand that proper lighting is necessary to operate a power saw safely

6. Safety

   a. Guards
   b. Pushers
   c. Height of blade
   d. Floor
   e. Lighting
   f. Fence block
   g. Green or wet wood

Show how to cut a 45° angle along the edge and end of a piece of wood by tilting either the saw arbor or the table, depending upon which type of saw is in the shop. Show how to unlock the shaft with the thumb set screw and explain that by turning the hand wheel, the 90° angle is changed to 45°. Call attention to the angle indicator and the marked quadrant so that the operator will stop at the desired angle. Point out why the shaft is to be locked again.

Demonstrate that by using the miter gauge set to the 45° mark 45° angles may be cut on molding stock to form the corner of a picture frame. Show that the angles may be cut left and right from the one setting.

Demonstrate that a tennon joint may be cut on the circular saw by marking the shoulder cut and cheek cut on the saw. Remind students that using a push jig is much more safe than trying to push the wood through freehand. Show how such a jig is used when making this joint. Show that the dado head will take off an entire side with one pass.

Call attention to the design and use of pushers, not only to push narrow stock but also to avoid kickbacks from a slightly dull saw blade. Impress upon the class the importance of having the pusher at the saw at all times.

Reiterate that a rip or crosscut saw should not project above stock being cut more than 1/8".

Floor conditions should be discussed, and it should be pointed out that it is dangerous to have slippery hardwood floors near a power saw. Remind the class that sawdust walked on creates a slippery surface. Instruct students that a corrugated rubber mat, or other nonskid material should be placed on the floor behind the saw.

Tell the class that proper lighting is necessary when operating a saw in order to do accurate work and to avoid injury.

Inform the class again of the importance of clamping a clearance block to the fence when cutting a number of short pieces from longer stock so that the wood will not be kicked back by the saw while it is running.

Remind the class that green wood, when ripped or cross cut, is very apt to bind on the saw and be kicked back. When ripping, it is often necessary to force a wedge into the kerf after a few feet have been cut in order to avoid the board closing and binding against the saw.

E. The jointer

  1. Jointer

    a. Face jointing
    b. Edge jointing
    c. End jointing
    d. Plywood jointing

Explain to the students how the jointer works with the knives fastened to the steel cylinder and how the cutting takes place on the lower surface of the stock as it is pushed forward.

Explain the function of the fence for cutting edges at right angles to the face of the stock.

Show that the jointer can be used to take "wind" and "warp" from the wood.

Demonstrate how a face is jointed on a piece of wood, calling attention to hand and finger placement.

Point out that the infeed table is adjusted, and that a cut of 1/16" or less is taken for each pass under ordinary conditions.

Mention that the pusher must be used if the board is under 18" in length.

Demonstrate that making cuts thicker than 3/32" is dangerous, for the wood is liable to be kicked back, especially if the knives are a little dull.

Demonstrate jointing one edge showing how the fence is moved in or out across the blades and how it is tested for being at a right angle.

Impress the students with the importance of having the jointed face against the fence, and the down pressure on the wood when it is above the feedout table.

Have the students notice that a small portion of the thumb projects down over the end. If a narrow board is to be jointed on the edge a special edge, pusher is necessary.

Remind the class that it is good practice to vary the cutting area of the blade when edge jointing so that the blade is not constantly used in one narrow section.

Demonstrate jointing an end by cutting into the board, one or two inches, then, reversing the board and completing the cut to avoid splintering the edges. Remind the class that jointing an end does not square it. The end must be sawed square first, then jointed.

Explain that a follow strip the same thickness as the stock being cut, and an inch or more wide, may be held tight against the stock and both pushed entirely through the machine instead of reversing the stock. This push stick must have a square end and fit perfectly against the edge of the stock to avoid splinters from forming. To joint end grain, the stock must be 10" or wider.

be able to make long and short tapers and to cut a rabbet

be able to cut a tenon and be able to adjust both tables to cut a recess

be able to adjust the fence to cut bevels, plain and stop chamfers

2. Special cuts

    a. Tapers
    b. Rabbets
    c. Tennons
    d. Recesses
    e. Bevels and chamfers

Explain to the students that in jointing plywood either of the above methods may be followed, but because of its construction, all plywood edges and ends are treated as ends.

Teach that the jointer is capable of producing a variety of special cuts. Demonstrate how a taper of 18" or 20" can be made on four sides of a 1½" square leg and still leave the top 4" or 6" square and parallel. Show how a stop block should be clamped to the table or fence so that all surfaces cut will be started at the same place.

Demonstrate cutting a short 2" or 2" taper on a similar leg using a supporting block between the face of the feedout table and the leg being tapered. Show that a stop block is again clamped to the table or fence to avoid having the leg thrown back by the machine. Call attention to the fact that the leg is pulled ahead rather than pushed, and the operator stands along side of the feedout table.

Demonstrate cutting a rabbet along the edge of a piece of 1" x 2" stock by removing the front safety guard, lowering the back table the depth of the rabbet, and bringing the fence up to the front edge so that the blades extend out the width of the rabbet. Show a test run on scrap wood to verify correct setting, before cutting the rabbet. Show the class how a block of wood, clamped to the fence above the stock being cut, will hold the wood down against the cutting knife. Explain that if a deep rabbet is to be produced, it is best to cut half the depth on the first cut and the true depth on the second cut.

Demonstrate cutting a tennon by removing the blade guard, lowering the feed table, and bringing the fence forward so that the tennon will be the correct length. Show the class the tennon marked out on a piece of wood in pencil so that it shows well. Proceed to cut it on the jointer, cutting off half on the first cut and the remainder on the second since it will produce a better job then doing it all on the first. There is less chance of "kickback". It should be pointed out that the stock should be held at right angles to the fence and that a jig could be constructed to hold them that way.

Demonstrate cutting a recess on the bottom of a table rail by lowering both jointer tables an equal amount. Indicate how to locate the stop blocks one clamps on the fence to start and stop this operation correctly. Have a recess marked on the piece of wood with a pencil so that the students will fully understand the cut desired. Explain that a deep recess ought to be cut in several steps to avoid chipping and kickback.

Demonstrate cutting a bevel and a chamfer on this machine by adjusting the fence to the proper angle and lowering the infeed table the correct amount. Remind the class again that it is better to take two cuts off the work rather than all on one cut.

be able to adjust the outfeed and the infeed table

be able to read the scale for amount of the cut to be made

be able to adjust the fence for angular cuts and for cutting at different areas along the knives

know the importance of and acquire the habit of disposing of waste shavings regularly

3. Adjustments and care

   a. Infeed table
   b. Outfeed table
   c. Fence table
   d. New lumber only
   e. Shavings disposal

Demonstrate cutting a stop chamfer by lowering the infeed and outfeed tables and clamping stop blocks the correct distance from the blades on the fence.

Demonstrate adjusting the outfeed table to the proper height by holding a straight edge 12" or longer on the table, then rotate the blade cylinder slowly and show the class that, if the blade touches the straight edge, this produces a recess on the last few inches of the work. Then, show how by using the hand wheel the outfeed table may be adjusted to the exact height.

Demonstrate, by raising the table too high, that work cannot be pushed across the blades and slid on the outfeed table; it will bump against the end of it. Set the feed table out about 1/8" too high and joint an edge on a piece of wood having parallel edges about 23" long.

Place the front end just on the outfeed table and joint it. Show by measuring that such a cut produces a taper instead of parallel edges. Caution the class that the adjusting wheel of the outfeed table should be turned only when a recess or stop chamfer is to be cut on the machine; otherwise it will be out of adjustment.

Demonstrate how the infeed table may be lowered 1/8" by first loosening the locking device found on most machines on the front side and then turning the adjusting wheel counter clockwise until the indicator on the scale mounted on the side of the machine registers at the 1/8" location.

Joint an edge several inches on a pre-jointed piece of wood. Show the class by holding a straight edge along the jointed sample that exactly the correct size was removed.

Demonstrate fence adjustment by jointing an edge after the fence has been set a few degrees off right angle. Show how to correct the setting to produce a perfect right angle and test it with a try square. Joint a piece of stock and test it, calling attention to the importance of placing the handle of the try square on the face of the stock that was placed against the jointer fence. Set the machine to 45°, joint an edge, and test it with a machinist set or bevel square to prove it has been cut to the desired angle. Point out the necessity of setting the machine about 1/8" for the first few passes and taking finer cuts for the finishing ones.

Instruct the class that only new lumber should be used on planing machines since there is always the danger of nails and other metal being imbedded in used lumber. (Teach that hardened wood fillers, paints, and varnishes dull the sharp edges of blades; wood with any of the above finishes should not be cut with the jointer.)

understand the importance of and acquire the habit of wood pushers to protect fingers

know that short pieces of wood are dangerous to push through the machine

understand that the guard covering the blades should be in position whenever the jointer is used

know the importance of keeping the cutting knives sharp at all times

be instructed regarding the necessity of treating the floor surface with non-skid material where the operator stands

4. Safety

   a. Pushers
   b. Length of materials
   c. Blade guard and fence guard
   d. Sharp blades
   e. Floor covering

Remind the class that shavings have a tendency to make wood floors slippery and to make it more difficult to maintain secure footing. All shavings should be removed daily.

Demonstrate the necessity of using board pushers when pushing the last foot of wood over the knives. Show how this device looks over the end of the wood and keeps the operator's thumb in a safe area. Call attention to the pusher construction, free of all metal. The several pieces are assembled by using pigs and glue so that should the blades cut into the pusher, the blades will not be nicked.

Impress upon the students that for safety of operation all wood used on the machine must be at least ten inches long in the direction of the edge jointed. Impress upon the students the importance of keeping the front blade guard in place whenever possible. Some jointers have a rear blade guard as an integral part of the fence.

Impress upon the students that sharp blades are safe blades and that dull ones have a tendency to beat the board back.

Impress upon the students that there should be a floor covering where the operator stands in order to reduce the chance of slipping. A rubber mat or one of the new grit containing heavy paints may be used to overcome the danger.

(References: 9, 11, 12, 16, 19, 20, 34).

understand the purposes of grinders and know the kinds of grinding wheels

learn to use the proper techniques for grinding such tools as plane blades, chisels, and twist drills, and how to avoid "burning"

be able to sharpen curved blades on the cone grinder

be able to "dress" the wheel and understand the use of holding devices or jigs while sharpening tools

be able to operate the grinder safely.

F. The grinder

1. Kinds of grinders

   a. Dry
   b. Wet
   c. Types of wheels

2. Methods of using

   a. Grinding on face
   b. Grinding on side
   c. Cone grinding
   d. Dressing or trueing and shaping wheel
   e. Attachments
   f. Whetting of ground edges
   g. Safety rules

Demonstrate the operation of the grinder, pointing out that there are coarse and fine wheels. The face of the dry grinder is for sharpening keen edge tools.

Point out that the dry wheel is an electric furnace product which runs at a high speed, and should be operated without a coolant. Indicate that tools are to be held to the revolving wheel lightly, moving them from side to side to lessen the heat caused from the grinding friction. Show that by holding the tool too long in one place, and/or by using too much pressure the tool will soon become overheated or "burned," thus removing the temper. Explain that it is better for the structure of the steel to allow the heat that forms to dissipate by itself rather than to quench the tool in water.

Explain that the wet wheel is a natural sandstone that has been quarried.

Explain that the wet wheel moves slowly compared to the dry wheel and should be run in a container of water to wash particles of steel from the wheel and to cool the steel. Some of these wheels have water dripping from above and just ahead of the grinding area.

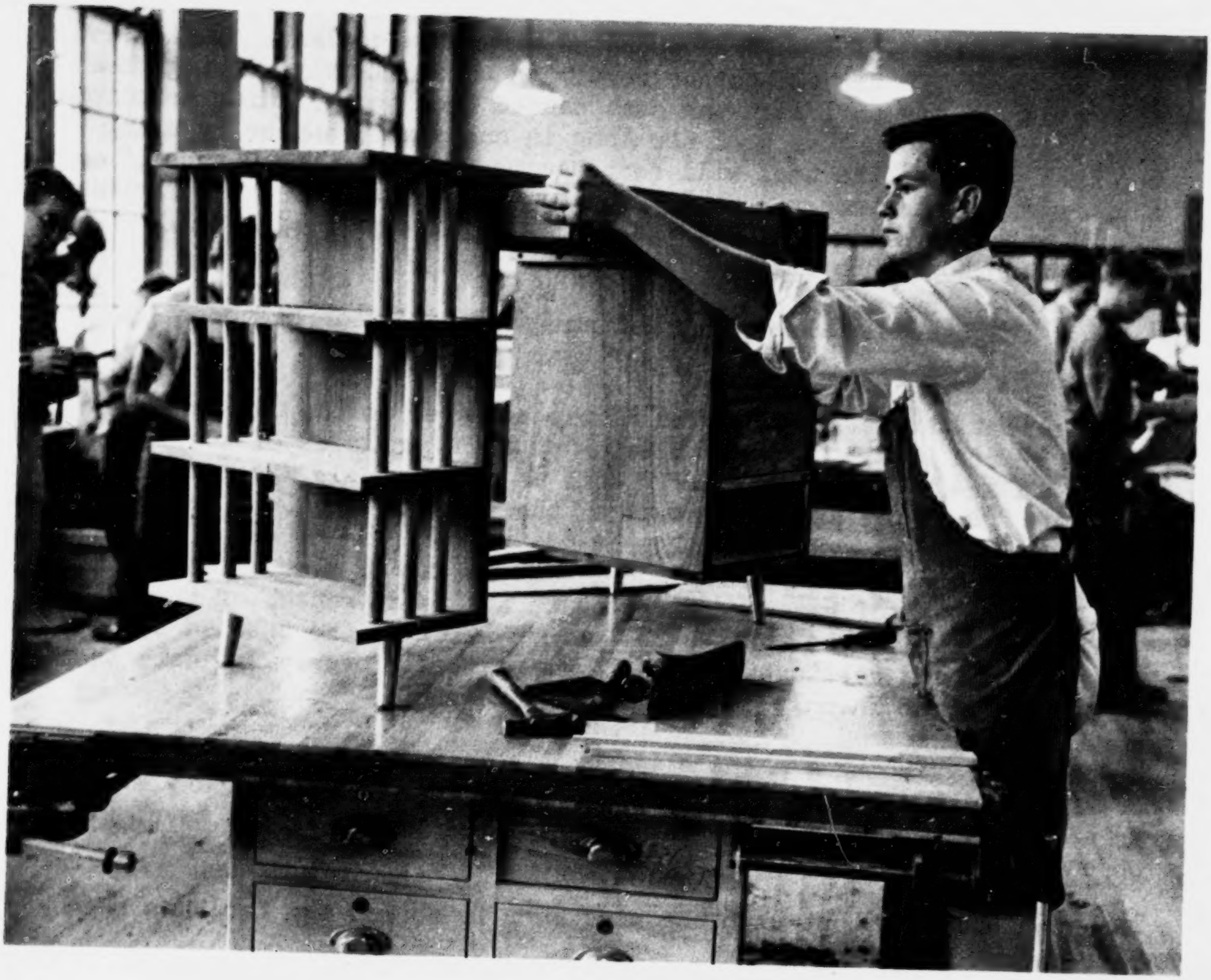
Also, discuss the slow running wheel that is washed free of steel chips by a fine stream of kerosene directed to an inside recess of the wheel. The thin oil is forced through the porous wheel to the outside surface for cleaning and cooling the tool by centrifugal force. Indicate that this wheel comes in only one "grit" or grade.

Demonstrate grinding a plane blade by fastening it into the tool holder or jig. Point out the necessity of determining the correct angle for grinding by sighting at the edge of the blade to see if the bevel will be cut properly.

Show the students that when the wire burr is formed the tool has been ground enough.

Emphasize the importance of keeping the tool in motion from left to right, of not exerting too much down pressure, and of allowing the steel to cool. The blade should not run entirely off the right or left side of the wheel, as this will either spoil the corner of the blade when it is brought onto the revolving wheel, or a chunk may be broken from the wheel where the corner of the blade digs into the wheel.

Demonstrate grinding the blade without the use of the tool holder by placing the tool on the tool rest and proceed as above. Demonstrate the proper manner of grinding wood, turning tools, such as gauges and scrapers, and show how the forearm rocks the tool from left to right. At the same time the tool's cutting edge is pushed up and down on the face of the wheel. Demonstrate that these tools may be ground on either side of the wheel, but that the bevel formed is not hollow ground.



Fitting a Drawer

Demonstrate sharpening a twist drill by doing it freehand and also by using a drill sharpening attachment. Distribute a few 3/8" to 1/2" twist drills so that the students may inspect a perfectly sharpened one for angle and rake. Sharpen a broken twist drill so that the class may see finger movement and approximate pivot point while sharpening. Cool the drill tip often in water.

Demonstrate grinding a hand gauge inside, such as a patternmaker's gauge, on a cone-shaped grinder. Include in the preparations a wood cone turned on a face plate to simulate the abrasive machine cone, and have a coat of emery dust glued to this cone. Use the wood cone to do internal grinding on a guage and explain that it is the method used when the better abrasive cone for the machine is not in the shop.

Explain the use of the smooth-grained flat wheel to whet the tools instead of the use of an oilstove. If such a wheel is in the shop, whet a ground tool for the students.

Demonstrate to the students how to resharpen a grinding wheel by using a spur dresser or a length of steel pipe. Explain how the sharp surfaces become broken off while grinding, and new sharp cornered piecespieces of grit need to be exposed for efficient cutting. Crooked wheels may also be straightened by using this same dresser.

Indicate that a jig to hold plane baldes to the correct angle may be purchased. One may also make his own holding jig.

Explain that care must be exercised in using the grinder. For safety, sleeves must be buttoned or rolled up. Ties must be inside the bib of the apron. The tool rest must be tight and only 1/8" away from the wheel. Objects must be firmly held with fingers or a holding device. Tools with corners are brought in contact with the revolving wheel without the corner being jabbed into the wheel. Wheels are run at the manufacturer's suggested speeds.

(References: 11, 12, 13, 16, 21, 30, 33).

UNIT IV: PROJECTS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Project #1 - a box
develop ability to fit parts of furniture together	1. Layout and cutting of stock
	2. Pieces squared to size
become proficient in attaching hardware, hinges, hasps, and locks	3. Fitting operations
	4. Sanding operations
become skillful in face plate turning	5. Assemblies
	6. Finish
	7. Apply hardware
develop ability to sand and finish a piece of work on the face plate	B. Project #2 - a bowl
become proficient in cutting miters	1. Layout and cutting of material to size
	2. Attaching of stock in lathe
develop skill in gluing miter joints	3. Turning bowl to template size
	4. Finishing on lathe
finish a picture frame	C. Project #3 - a frame
learn to place a picture in a frame	1. Cutting a contour of frame
	2. Cutting of a rabbet
	3. Cutting of miters
	4. Fitting of mitered joints
	5. Finishing of frame

SUGGESTED LEARNING EXPERIENCES

Project #1 - a box

(References: 5, 10, 12, 15, 23, 25, 32, 33).

Project #2 - a bowl

(References: 5, 16, 23, 25).

Project #3 - a frame

(References: 5, 11).

become skillful in making rabbetted, miter, and half-lap joints

develop ability to fit the ends, sides

gain experience in applying a design to a tray

D. Project #4 - a shadow box

   1. Layout and cutting the four sides to sizes
   2. Fitting the corner joints (either miter or rabbet joint)
   3. Making of half-lap joint in overlapping members
   4. Sand
   5. Assembling
   6. Finishing

E. Project #5 - a tray

   1. Cutting of veneer or plywood for bottom of tray and tray sides and ends
   2. Fitting of sides to bottom
   3. Fitting of ends between sides and to bottom
   4. Sanding, finishing, and decorating of the tray

Project #4 - a shadow box

(References: 5, 15, 32, 33).

Project #5 - a tray

(References: 5, 8, 10, 15, 21, 33).

learn to layout curves on a grid

develop skill in use of jig saw or band saw in cutting curves

develop ability to cut dado, dovetail and housed joints

learn to assemble and fit drawers into a shelf

develop skill in applying drawer pulls

F. Project #6 - a shelf

1. Layout and cutting of pieces
2. Dressing to proper dimensions
3. Layout and cutting of dado joints
4. Sanding of pieces
5. Assembling of the shelf
6. Cutting and fitting of drawer parts
7. Cutting of dado joints in drawer parts
8. Cutting of the housed joints or dovetail joints for drawer fronts
9. Assembling of drawers
10. Fitting of drawers into shelf
11. Finishing
12. Attaching of drawer pulls

Project #6 - a shelf

(References: 5, 8, 11, 14, 15, 16).

learn to shape irregular pieces of furniture

develop skill in turning legs and stretchers

learn how to drill holes for fitting legs, stretchers, and tops together

G. Project #7 - a stool

1. Study of the drawings and preparation of bill of materials
2. Layout and cutting of pieces to size
3. Shaping of top and turning of legs and stretchers
4. Drilling of holes for fitting legs to top and stretchers in legs
5. Sanding of wood
6. Temporary assembling
7. Disassembling
8. Adjusting
9. Final gluing

PROJECTS

Project #7 - a stool

(References: 6, 8, 16, 23, 23, 28).

develop ability in sketching and designing a project

gain experience in cutting and shaping a wood carving

learn to use a carved figure as a part of a small pice of furniture

H. Project #8 - book ends

1. Designing and making of sketches and drawings of project
2. Layout and cutting of stock
3. Shaping of the wood blocks to be carved
4. Carving of the figures
5. Sanding of figures
6. Shaping of other parts to size and sanding
7. Drilling of holes
8. Assembling
9. Finishing

Project #8 - book ends

(References: 8).

gain experience in working with a project requiring wiring and composed of both wood and metal

learn to design or select a harmonizing shade for a well-designed lamp

I. Project #9 - lamps

1. Selection of a design or creating own for a lamp
2. Layout and cutting out of parts
3. Use of lathe to cut ornamenation in base
4. Sanding of parts
5. Fitting of parts together
6. Assembling temporarily
7. Disassembling
8. Drilling of hole for threaded pipe
9. Reassembling
10. Wiring of lamp
11. Finishing
12. Making or purchasing of harmonizing shade

Project #9 - lamps

(References: 8, 11, 15, 16).

learn to work with plywood as a basic material in furniture construction

J. Project #10 - magazine stand

1. Selecting or making of a modern design for this project
2. Layout and cutting of materials
3. Use of steam vat and forms for shaping plywood
4. Fitting of parts together
5. Making of decorative cuts
6. Sanding
7. Assembling
8. Finishing

Project #10 - magazine stand

(References: 8, 11, 15, 16, 28).

acquire skill in making mortise and tenon joints

learn the essentials of good drawer construction

develop skill in making a small piece of fine furniture.

K. Project #11 - a stand

1. Selection of drawings for the construction of stand
2. Layout and cutting stock to size
3. Dressing of each piece to size
4. Cutting of mortise and tenon joints
5. Temporary assembling
6. Necessary adjusting in fitting of parts
7. Assembling
8. Construction of drawer for stand
9. Drilling of holes for attaching drawer pulls
10. Sanding of stand
11. Finishing
12. Attaching of hardware

PROJECTS

Project #11 - a stand

(References: 11, 15).

TEACHER'S NOTES

WOODWORKING IV INTRODUCTION

Woodworking IV is a continuation of the previous semester's work. However, since this is the fourth semester of woodworking, emphasis should be placed on the development of skills and quality craftsmanship.

New operations will be performed on power machines and, as a result, a greater quantity of skilled work can be accomplished. Larger projects can be constructed and they should be professional in quality.

The hand tools used during this semester are of a specialized nature and are used mainly for specialized operations.

On the power tools which have already been described in Woodworking III new operations will be performed.

The projects in this semester's work are all grouped in one unit; each project requires the use of many hand and power tools. Choice of the project to be made should be on the basis of the pupil's ability, interest, and need.

UNIT I: HAND TOOLS

UNDERSTANDINGS

The student should:

learn to use the drill and become skillful in its use

know when to use the automatic drill in place of the hand drill or the portable power drill

be able to use the expansive bit

know about Foerstner bits and their use

become skillful in using screwdriver bits

use combination drilling and countersinking bits to make pilot holes for wood screws

become proficient in the use of a depth gauge for boring or drilling a hole

OUTLINE OF CONTENT

A. Automatic hand drill

B. Special bits

  1. Expansive
  2. Foerstner
  3. Screwdriver
  4. Combination drilling, countersinking or counterboring
  5. Gauges

SUGGESTED LEARNING EXPERIENCES

Demonstrate the use of the automatic drill for drilling pilot holes for screws. Display the various sizes of drill points. (References: 9, 12, 13, 16, 21, 33).

Show how the expansive bit is adjusted for boring holes of a certain diameter. Explain that these bits are used for boring holes of more than one inch in diameter. Have pupils use this bit to gain experience in using it for boring large diameter holes. (References: 9, 11, 12, 13, 16, 21, 33).

Explain and demonstrate that Foerstner bits are used to bore holes where there is no lead screw hole left in the wood, or when boring a hole near the end of a piece of wood.

Screwdriver bits are available in several different sizes and are to be used with the hand brace. Show how these bits can be used to tighten large wood screws. Explain why a screw can be driven tighter with a screwdriver bit than with the conventional screwdriver.

Recently a new type bit has been developed for boring a hole and countersinking in the same operation. Show how a tool of this type is a time saver when building a piece of furniture requiring a number of wood screws. There are several companies manufacturing these bits. Secure one or more kinds for exhibit and demonstration purposes. One such make is "Screw Mate", another is "Circle Sink".

Demonstrate how a gauge is used on a wood bit to bore a hole to a predetermined depth. Describe several kinds of depth gauges. If possible have some on exhibit on the various kinds of bit gauges.

(References: 9, 12, 13, 16, 21, 33).

become skillful in using Phillips screwdrivers, and selecting the right size for the screw to be driven

know when and how to use the offset screwdriver

recognize the advantage in using a ratchet or spiral ratchet screwdriver

develop skill in the use of the spiral, ratchet screwdriver

understand how the cabinet saw is used

know how to use the compass and dovetail saws

know the difference in blade and tooth construction of the cabinet saws

C. Special screwdrivers
   1. Phillips
   2. Offset
   3. Ratchet
   4. Spiral ratchet

D. Miscellaneous saws
   1. Cabinet
   2. Compass
   3. Dovetail
   4. Hole

Demonstrate the use of each of these special screwdrivers and point out the advantage of each type.

There are tools which may not be used as often as other tools in the tool cabinet. It is well to have them labeled and/or arranged in a display.

(References: 9).

Display cabinet, compass, dovetail, and hole saws as special-use saws; explain briefly where each is used.

Demonstrate that a cabinet saw, having different teeth along each edge, may be used for cross cutting, ripping, or miter work when a small piece is to be cut.

Demonstrate that a compass saw, with a narrow body, is capable of cutting along an arc. Point out that it contains combination teeth so that it may cut across and with the grain.

Demonstrate the use of a dovetail saw to make the fine cuts necessary when constructing dovetail joints.

Demonstrate the use of a hole saw to put holes in boards. Attach one to a drill press chuck and saw a hole in a board. Show that a different-sized hole can be made by changing the blade.

Compare the cabinet, compass, and dovetail saws for:

1. Tooth shape and size
2. Body shape and size
3. Handle shape
4. Blade reinforcement
5. Blade thickness.

Make an end cut with each saw on a piece of 1" x 4" wood and compare the cuts each saw makes.

Do the same for a ripping cut.

know that most woodworkers use metal spokeshaves

know that patternmakers favor spokeshaves made of wood

know that special shaped spokeshaves are manufactured for specific work

be able to use a spokeshave

understand how to set the blades of both steel bodied and wood bodied spokeshaves

know that curved edges are smoothed by using a spokeshave

learn that rounds, as hammer handles and similar shapes, may be produced by using a spokeshave

understand how blades of wood and metal spokeshaves are ground and whetted

learn how to prevent the tool from rusting and how to store spokeshave when not in use

E. Spokeshave

1. Kinds
   a. Metal
   b. Wood
   c. Special designs

2. Use
   a. Set blade
      (1) Metal
      (2) Wood
   b. Edge grain
   c. Rounds
   d. Models

3. Care
   a. Sharpen blade
   b. Prevent rust
   c. Storage

Show the class a spokeshave and explain that it is similar to a plane; it has a big body and has two short handles on the sides.

Demonstrate the use of a spokeshave to smooth a precut curved edge which is impossible to plane. Show the edge smoothed, superior to filing.

Indicate that the steel spokeshave is the type most widely used.

Note that some woodworkers use one with a wood body.

Explain that some spokeshaves are made with a double blade holding body; the regular straight blade, and a curved blade or a blade to form chamfers.

Demonstrate placing the thumbs behind the blade (some have a depressed place for the tip of the thumb) while the first finger of each hand is placed in front of the blade and a bit to the side. (Some have a place for these fingers.) The rest of the handles are grasped by the remaining three fingers of each hand.

Demonstrate holding the tool level (right angle to board in vise) but slightly twisted, one handle a bit ahead of the other, to produce a shearing cut. Reverse this forward handle to the backward position from time to time.

Demonstrate adjusting the blade in a metal body spokeshave by unlocking the knurled locking screw on top of the blade, loosening the set screw, and slipping the blade up or down, then locking it in the correct position. Newer designs have knurled thumbscrews on each side of the blade for elevating or depressing the blade.

Show that tapping the protruding tips of the wood bodied blade on the bench sets the blade to cut coarser, and that tapping on the opposite side sets the blade to cut finer.

Demonstrate that the metal and wood blades have to be ground by holding them free hand against a grinding wheel.

Demonstrate how each blade is whet to sharpen and remove burrs.

Demonstrate pushing the tool forward fast to avoid the "chatter" that produces nicks in the wood. Explain that one does not go against the grain. A good rule to follow is to go from the wider areas of the wood toward the narrower ones, or down hill.

Demonstrate why the spokeshave is not to be used to smooth straight surfaces, since the face is short.

know the difference between socket and tang wood chisels

understand meaning and use of butt, mortise, paring, and socket chisels

develop skill in chiseling out the "gain" for a hinge

be able to use the proper chisel in cleaning out and smoothing a mortise

know the proper chisel to use in paring cuts on inside and outside arcs on the edge of a board

always keep hands behind the cutting edge of the chisel

learn how chisels are measured and sized

develop skill and understanding in grinding and sharpening chisels

F. Chisels

1. Types of wood chisels
   a. Construction
   b. Use
2. Uses of chisels
   a. Fitting of hinges
   b. Cutting of mortises
   c. Paring
3. Safety precautions
   a. Way to hold the chisel
   b. Way to hold the work
   c. Need for sharp chisels
4. Grinding of the chisels
   a. Proper angle
   b. Keep chisel cool
   c. Dressing grinding wheel
5. Sharpening or honing of chisel
   a. Use of the oilstone
   b. Test for wire-edge or feather edge
   c. Stropping on leather or using steel for burnishing

Demonstrate turning a square stick into a round one by using a spokeshave, being careful to avoid going against the grain. Explain how this tool will remain free of fust if a coat of thin oil is wiped on the unpainted surfaces. Tell how salts from the body are deposited on any surface when one touches it, and unpainted metal surfaces then become oxidized (iron-rusted) quicker.

Explain whey the spokeshave, when not in use, should be hung on a tool panel, blade away from the panel for protection.

(References: 9, 12, 13, 16, 21, 33).

Display as many types and kinds of wood chisels as can be assembled. Provide drawings or charts showing types and differences. Demonstrate, using a prepared board with mortise laid out, the method of using a mortise chisel to clean out corners left by boring out excess wood. Demonstrate, using a prepared board with hinge "gain" drawn out, the method of cutting to insert a hinge.

Call attention to the construction of handles: the leather tops, the ferrule top, the high impact plastic handle. Call attention to the construction of blades for different purposes. Demonstrate how a paring chisel is used to smooth a contoured edge. Show how the chisel is held for vertical paring and how to use scrap wood to prevent splitting.

Demonstrate how a lap joint should be pared from each side to the middle to avoid chipping the far edge. Demonstrate how to set the grinding wheel tool rest to give the proper 25° angle. Show how to dress the wheel when out of round or grooved. Demonstrate the use of the oilstone and the strap.

(References: 5, 9, 12, 13, 16, 21, 33).

know that the miter box is a device to hold wood for cutting accurately and that a large back saw is used in guides

know how a miter box can be made in the shop or at home

know that the angle this machine will cut from base to saw is 90°

learn the angles the saw will cut measuring from back to saw

understand the importance of labor saving devices

G. Miter box

1. Kinds and parts
    a. Use
    b. Parts
        (1) Saw and guide
        (2) Frame
        (3) Attachments
    c. Setting angles on machine
2. Angles
    a. Basic
    b. From back
    c. Setting angles on machine
3. Sizes made
4. Labor saving devices

HAND TOOLS

Show a miter box and saw and explain the advantages of using a miter box saw. Explain its use to cross cut wood up to the width of the machine. Explain that the 24" or 30" back saw is used for a manufactured miter box and runs in metal guides for accuracy, while an ordinary panel saw may be used in a homemade box. Demonstrate how the guides are locked to an elevated position and are released when the operator wants to lower the saw for use.

Show that an attachment may be applied to the saw frame to cut a number of pieces the same length. Show that a block of wood clamped to the back of the frame will do the same thing when short pieces are to be cut. Show that attachments are used to hold the wood to be cut firmly against the back of the machine and then that a handscrew or "C" clamp will do the same thing. Demonstrate how one may build his own miter box from 1" x 4", layout 90° and 45° angles, and make the cuts for sawing projects. Demonstrate that it is tested for right angle from the base, or bottom of the board.

Demonstrate that angles are tested from the back edge of the box to the saw. Cut an end of a narrow piece of wood 45° and test with a combination square. Demonstrate that the miter box saw may be adjusted to cut 30° to the right, or 30° to the left. Call attention to the unlocking device below the segment on which the angles have been marked. Show that the device is locked into position before sawing.

Discuss the several sizes of boxes one may purchase, some rather simple and inexpensive - others with attachments, accurately made and expensive. Call attention to the amount of accurate work one may produce using a miter box compared with hand work alone.

(References: 9, 12, 19, 21, 23).

know the sizes and become skillful in using nail sets

develop skill in using the cornering tool

understand the use of the "Surform Tools" in reducing wood stock to approximate size and shape.

H. Nail Set
    1. Sizes
    2. Uses
I. Awl
    1. Brad
    2. Scratch
J. Cornering tool
K. "Surform Tool"

Demonstrate the use of the nail set to drive a finish nail below the surface of the wood. Caution the students not to drive the nail too far before using the nail set because of the danger of scarring the wood surface. (References: 9, 13, 16, 21).

Deisplay both brad and scratch awl. Demonstrate the effectiveness of each. The brad awl is for making pilot holes for small wood screws or for nails, and the scratch awl is for scratching guide lines on surfaces, such as formica. (References: 9).

Have available for use a cornering tool for rounding off sharp edges of wood work. Demonstrate the use of the cornering tool, calling particular attention to its use with the grain of the wood.

"Surform tools" are of recent origin and have decided advantages when used in certain operations, such as roughing in operations. Demonstrate the use of the "Surform File" and the "Surform Plane." Explain that these tools are not to be used for finishing operations.

(References: 12).

UNIT II: POWER TOOLS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Router
know that there is a portable and a stationary production router	1. Kinds a. Production machine b. Portable
understand the uses of the router	2. Cuts
know how to adjust the machine on the use of shaped cutters	a. Adjusting and cutters b. Freehand and pattern c. Edge shaping d. Molding e. Guides
understand that the worker may operate the router freehand, or with a jig or pattern	3. Cuts made
know that edges of projects may be shaped by using a router and that various molding designs are available	a. Grooves b. Dados c. Gains d. Mortises e. Dovetails f. Background removal
understand that guides are furnished with the machine for producing accurate work	
understand how the dovetail joint may be produced using the router and dovetail adjustment	
know how background material may be removed with the router in patternmaking or wood carving	

SUGGESTED LEARNING EXPERIENCES

Discuss two types of router machines, the stationary production machine and the portable type. Indicate that their speeds are from 8,500 to 20,000 R.P.M. Discuss the use of the machine and show samples of some of the ordinary cuts the router is capable of producing. Demonstrate that the machine is set up and adjusted for a specific job, and call attention to several cutters made to produce standard cuts. Show how cutters are locked in the machine. Demonstrate how the portable router may be used free hand by cutting a vein into a surface of a panel. Indicate that some newer machines have a light under the bottom to illuminate the lines being followed.

Set up a pattern, or jig, on a panel and do similar cutting to demonstrate this method of routing, expecially where a number of duplicate pieces are to be made. Demonstrate that a small table top edge might be shaped by using a bending or rounding-over bit, cautioning that when cutting across the grain several shallow cuts should be taken to avoid "kick-back". Also allow the pilot tip to guide the tool along the edge of the board on the final passes. Show the different router bit shapes and samples of the cuts they produce. Demonstrate setting the guides that come with the router machine, and suggest how the operator may make additional ones. Explain the use of the guides to help produce accurate cuts.

Lock a straight bit into the machine and demonstrate cutting a groove along the edge of a board so that a plywood point might be fit into the groove. Explain that several shallow cuts will produce better results than one deep one and that there will be less chance for spoilage because of machine "chatter". Demonstrate the same cutter used to produce a dao on the ends of a board so that a bottom shelf of a cabinet may fit into the side of the cabinet.

Demonstrate that a gain can be cut into the stile of a door for a room by having an appropriate jig made up in advance for this. Call attention that the cutter makes an arc corner which must be hand trimmed with a wood chisel. Demonstrate how to produce a mortise joint by using the same cutter. If a wider mortise is required than the size of the cutter two passes would be required, adjusting the fence for each cut. Demonstrate how the router may be used to produce both parts of the dovetail joint to connect drawer sides to the front. Show how the special cutters and attachments are adjusted to produce this joint.

Show that background wood may be removed by using a straight bit and having the machine regulated to the desired depth. Explain that this might be used to recess a cabinet lock on the inside of a cabinet door. Demonstrate, or describe how a drill press may be used for doing routing work. Explain that a special heavy duty quill is recommended to avoid "chatter."

understand how to handle the machine in a safe manner and how to keep the cutter tight

understand that the electric plug on a shaper should be grounded for safety

know how a planer functions, that planers come in different sizes, and that they are measured both by the length of the blade and the thickness of the cut

understand that production machines have double cutters, one on top and the other below, while in smaller shops single cutters are used and are located above the board being planed

learn that parts of a planer are frame, table rollers, infeed and outfeed rollers, table, chip breaker, cutter head, and pressure bar

4. Drill press routing
5. Safety
    a. Installing of cutters
    b. Handling
    c. Grounded plug
    d. Proper wrenches

B. Planer
1. Kinds
    a. Single cutter
    b. Double cutter
    c. Sizes
2. Mechanism
    a. Frame
    b. Table rollers
    c. Infeed and outfeed rollers
    d. Bled
    e. Chip breaker
    f. Cutter head
    g. Pressure bar

Demonstrate how router bids may be replaced in the machine safely by first disconnecting the machine oonnection. Call attention to the fact that the machine must be securely held while it is in operation and that several shallow cuts are safer to make than one deep cut. Remind the class that sharp cutters are safer to use than dull ones and that dull ones leave a fuzzy fiber remaining on the surface where they tear the wood fiber. Remind the class that a three prong ground plug should be installed on the machine to avoid electric shocks that might be caused by the conventional two prong plugs usually furnished. Explain importance of having proper fitting wrenches for replacing cutters.

(References: 11, 12, 19, 20, 21, 26, 30, 34).

Point out that the planer does work similar to the jointer but that the revolving blades are above the board on the single cutter machine and that larger machines, to increase production, have cutters both above and below the stock being planed. Cite also that an innovation of the production machine is the "Straitoplane", which first joints the board and then planes it to the desired thickness, all in one operation. This is an expensive tool. Describe how the machine is first set to 1/16" less than the thickest part of the board and that power delivered to the rollers automatically pushes the board against the revolving knives fastened to the cutter head. Point out that back rollers pull the board, now planed on the top surface, from the machine. Inform the class that the sizes of planers vary from ones having cutter blades 12" long to those used in the large mills having 4-ft. long blades. Tell them that the machine is also measured by the thickness of stock that may be run through, as 5" for a 12" machine or 6" for an 18" machine. Point out that a planer only smoothes the board and does not level it. If a board contains "warp", it will have the same amount of warp after it has been planed.

Explain how the planer mechanism operates by taking off the safety hood of the shop planer or by supplying a cross section drawing for the students for a book so that they can understand how the table is raised and lowered to produce thicker or thinner cuts. Point out where the table rollers are located, and that the infeed and outfeed rollers are power driven and located directly above the table rollers. Mention that the table rollers project about 3/32" above the table. Show how the infeed roller is corrugated lengthwise to grip the wood fed into the machine while the outfeed roller is smooth so that it will not mar the planed surface. Explain the function of the chip breaker that rides on the wood between the infeed roller and the cutter head. Describe briefly how the cutter head contains three, five, or seven blades clamped on a steel cylinder. As the cylinder revolves against the board being pushed below it, cutting takes place. Show where the pressure bar is located and explain that it helps to hold the board tight to the bed as it passes through the planer.

understand how the machine may be adjusted for thicker or thinner cuts when planing	3. Operation a. Setting b. Feed (many) c. Stock wood d. Size of stock e. Delivery
learn how to feed boards into the planer and know the capacity of the machine, from the thinnest to the thickest cuts	
know how to avoid corrugated marks across the board and how to prevent chipped edges	4. Irregular cuts a. Ridge b. Groove c. Corrguated d. Chipped edge

Demonstrate how a rough sawed board is planed to a specific thickness. Show how the pointer on the scale indicates how thick the board will be when it comes out of the machine. Set the machine 1/16" less than the board measures and run it through. Explain that if a number of boards were to be planed the same thickness, all of them should be run through for a first cut. The machine should be reset 1/16" smaller and all boards again run through, this time for the other side to be cut.

Point out that the grain should be watched when feeding the board into the machine so that no undue chipping takes place, and also that chips should be brushed or blown off the feed table so that the finished surface that is below does not become dented and marred by the chips. Demonstrate how the boards are to be stuck quickly into the feed roller so that the roller will grip them. Call attention to the wood being sent straight through the machine rather than at an angle; discuss the reason. Explain that short boards should be fed into the machine end to end in a continuous manner, to achieve the same result as machining one long board.

Explain that the operator should always stand to one side while the machine is planing wood to avoid serious injuries from any kickback. Advise that if a piece becomes stuck while the machine is in operation it may be freed by a bit of driving forward with a heavy piece of stock, such as a 2 x 4. If it continues to stick, the power should be shut off, the feed table lowered, and the wood removed. Caution that one must be sure not to have fingers below the board being fed into the machine, otherwise painful injuries may result. Instruct the class that the operator should be familiar with the capacity of the machine so that he will know how thin or how thick the stock may be planed. Be prepared to handle long and short boards when they leave the machine after planing.

Demonstrate how the clutch may be engaged and disengaged while a board is being planed so that the students will know how to stop the feeding. Display a sample of, or illustrate on the chalk board, some of the things that are wrong with the machine under conditions as: A ridge left on the surface running the length of the board may be caused from a nick in the blade, from a nail or other metal in a board that had been planed, or a ridge may indicate that the infeed table roller is too high. Corrugated feed roller marks left on the wood as it is pushed out of the machine are caused by the machine being set just a little too high for the blades to plane off wood, and are caused when working woods that are especially soft. Demonstrate how a chipped edge may be made if a board is run through the planer at quite an angle, especially if cross grain hardwood is being worked. Show how a board having wind needs to be leveled on one surface first before it may be planed to the desired thickness. Plane one piece of wood without jointing and a second after one face has been jointed to show how the wind will remain if no jointing is done.

understand how to plane twisted boards and know the minimum length of wood that may be safely run through the machine

know that fingers are to be kept away from the machine while it is in motion

know the proper place to stand when operating the planer

know the danger of looking into the feed area of a running machine

know that sharp knives are safer than dull ones.

5. Safety

   a. Jointing of twisted wood first
   b. Length of wood
   c. Hands on rolls
   d. Fingers below wood
   e. Stand on side
   f. Do not look in machine
   g. Sharp knives
   h. Clean rollers and floor

Explain that boards to be planed must be several inches longer than the distance from the infeed to the outfeed rollers. If the board is shorter than the roller distance a serious accident will occur. Suggest that on smaller machines 12" is the minimum length for safe operating. Show how wood is fed into the infeed rollers, calling attention to finger placement on board in relation to the feed table. Stop the machine and then demonstrate how the fingers should NEVER BE CURLED BELOW THE BOARD. Demonstrate that by standing to the side, when operating the machine, one will not become injured by a piece of wood forcefully thrown back by the machine.

Stress the importance of NEVER LOOKING INTO THE FEED AREA while the machine is running, for a board or loose knot may be kicked back into one's face. Inform the students that it is necessary to maintain sharp knives in the machine to secure good performance from the machine. Teach them that operating with dull knives has a tendency to throw the machine out of proper adjustment, cause unnecessary overhaul bills, and do inferior planing.

Explain that the infeed table should be clear of wood chips if a dent-free surface is expected. Rollers need to be scraped free of gums and resins and washed with a solvent from time to time. The floor should be kept free of shaving and debris.

(References: 9, 11, 19, 20, 21).

UNIT III: PROCEDURES

UNDERSTANDINGS

The student should:

become familiar with the tools and materials used in simple upholstery

learn to tack, stretch, and fasten webbing to a frame

be able to fasten burlap over the webbing

develop ability to spread curled hair, moss, or tow over burlap on slip seat frame

become skillful in adjusting stuffing with regulator for smoothness

become familiar with applying burlap covers with cotton padding and muslin covers

develop skill in applying final upholstery material

develop skill in upholstering over coil springs

become faimilar with upholstering over wire edge coil spring

OUTLINE OF CONTENT

A. Upholstery

1. Materials
   a. Webbing
   b. Burlap
   c. Stuffing materials
   d. Cotton
   e. Muslin
   f. Cambric
   g. Sewing twine
   h. Spring twine
   i. Tacks
   j. Springs
   k. Covering
2. Tools
   a. Tack hammer
   b. Regular
   c. Straight needle
   d. Curved needle
   e. Webbing stretcher
   f. Shears
3. Upholstering of a slip seat
4. Upholstering over coil springs
5. Upholstering over a wire edge coil spring

PROCEDURES

SUGGESTED LEARNING EXPERIENCES

Have a display made of the various kinds of materials used in doing upholstery work.

Demonstrate the use of each of the tools for upholstery work. This should be done while demonstrating the techniques of doing simple upholstery on a slip seat.

Have samples of cloth and plastic upholstery coverings available for pupils to inspect.

Examine a webbing stretcher and show how it can be used to get various degrees of tension in the webbing.

Have a display showing each step of a coil spring upholstery job.

Demonstrate uphlostering with the wire edge coil spring construction.

(References: 1, 2, 3, 4, 16).

learn of procedures and processes in the manufacture of laminated plastics

become skillful in the layout and cutting of plastic laminates

develop ability in the cementing of the plastic laminate to wood backing

learn how to handle sheet laminates so that they do not become scratched

know the procedures in attaching trim to furniture with plastic laminate surfaces

develop a high degree of skill in attaching drawer pulls

learn how to install door handles on cabinet work

become proficient in the installation of door catches

develop ability to install a drawer or cabinet door lock and strike plate

develop ability to install in a craftsmanlike manner the following kinds of door hinges: surface, plain flush butt pin, tight butt, concealed and semi-concealed

know the procedures involved in installing a table leaf hinge and support.

B. Plastic laminates (formica)
    1. Manufacturing processes
    2. Fabrication
    3. Gluing or cementing
    4. Applying of trim
    5. Uses

C. Cabinet hardware
    1. Drawer pulls
    2. Door handles
    3. Catches
    4. Locks
    5. Hinges
    6. Table leaf hinges and supports

PROCEDURES

Have available for inspection various colors of plastic laminates.

Demonstrate the uses of tools in layout, cutting, and cementing pieces of plastics.

Show how the clamp and clamping devices are used to exert pressure to make a good cemented joint.

Demonstrate that plastic laminates should be lifted and not slid on another surface, so that the surface does not become scratched.

Have available for student inspection some of the common types of trim used with plastic laminate.

(References: 26).

Have an exhibit of the common kinds of cabinet hardware.

Demonstrate the correct procedure for installing a drawer pull, a door handle, a door catch, a drawer or door lock, and a surface hinge.

Give assistance to students having special or unusual types of hardware for installation on their projects.

Provide catalogues of companies having cabinet hardware for sale so that the pupils may inspect them.

Call attention to the various styles of hardware as it relates to the period of the furniture.

Stress the quality of workmanship to be performed on projects and the neatness required on the installation of hardware.

(References: 11, 12, 16).

UNIT IV: PROJECTS

UNDERSTANDINGS	OUTLINE OF CONTENT
The student should:	A. Project #1 - a table
become skillful in making a bill of materials	1. Choosing of a design and drawing
	2. Making a bill of materials
develop some ability in laying out and cutting mortise and tenon joints	3. Obtaining of necessary materials
	4. Laying out of parts on stock
be able to assemble a small piece of furniture in a workmanlike manner	5. Cutting of pieces to size
	6. Cutting of joints and temporary fitting of parts
skillfully apply stain, shellac, filler, and varnish finish to furniture	7. Finishing of pieces
	8. Gluing and assembling permanently
	9. Application of finish

PROJECTS

SUGGESTED LEARNING EXPERIENCES

Project #1 - a table

(References: 5, 6, 8, 11, 12, 14, 15, 16, 18, 23, 24, 28, 33).

become skillful in cutting and fitting drawers, drawer slide rails, and cabinet construction

develop craftsmanship in assembling and fitting a good piece of furniture

gain some experience in applying a lacquer finish

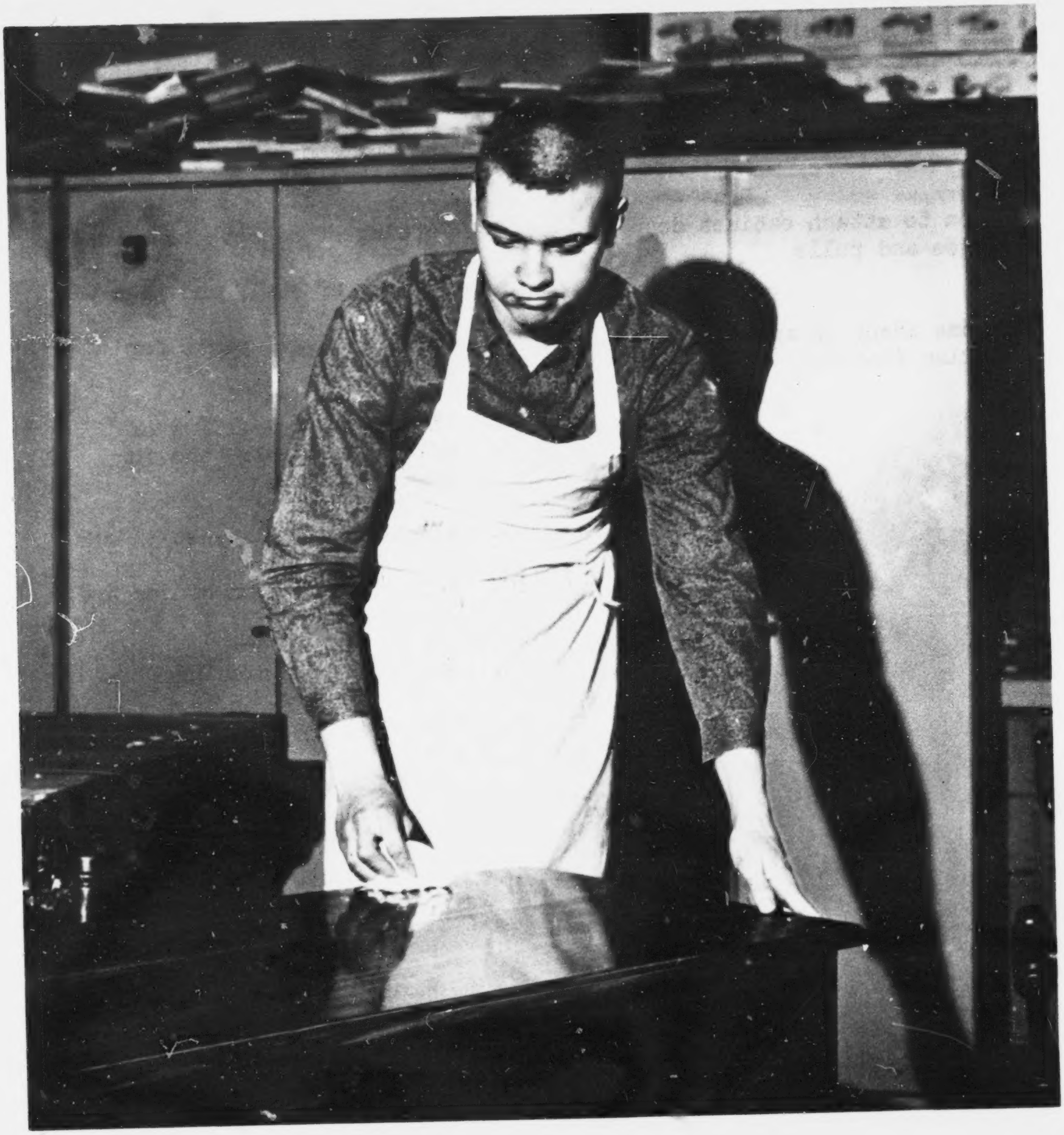
develop ability in attaching drawer pulls

B. Project #2 - a desk

1. Lay out and cutting of stock for cabinet section
2. Sanding
3. Cutting and rabbeting of stock for drawer slide rails
4. Fitting and sanding of cabinet parts of a desk
5. Temporary assembling
6. Adjustment of fitting, sanding, gluing and assembling
7. Cutting and fitting of top
8. Sanding of top
9. Assembling of cabinet
10. Finishing
11. Attaching of drawer pulls

Project #2 - a desk

(References: 5, 8, 12, 14, 24, 28).



Finishing a Desk

learn to cut and fit a shelf in a cabinet

become proficient in cutting and fitting cabinet parts

attain skill in making doweled joints

learn to attach cabinet door hinges and pulls

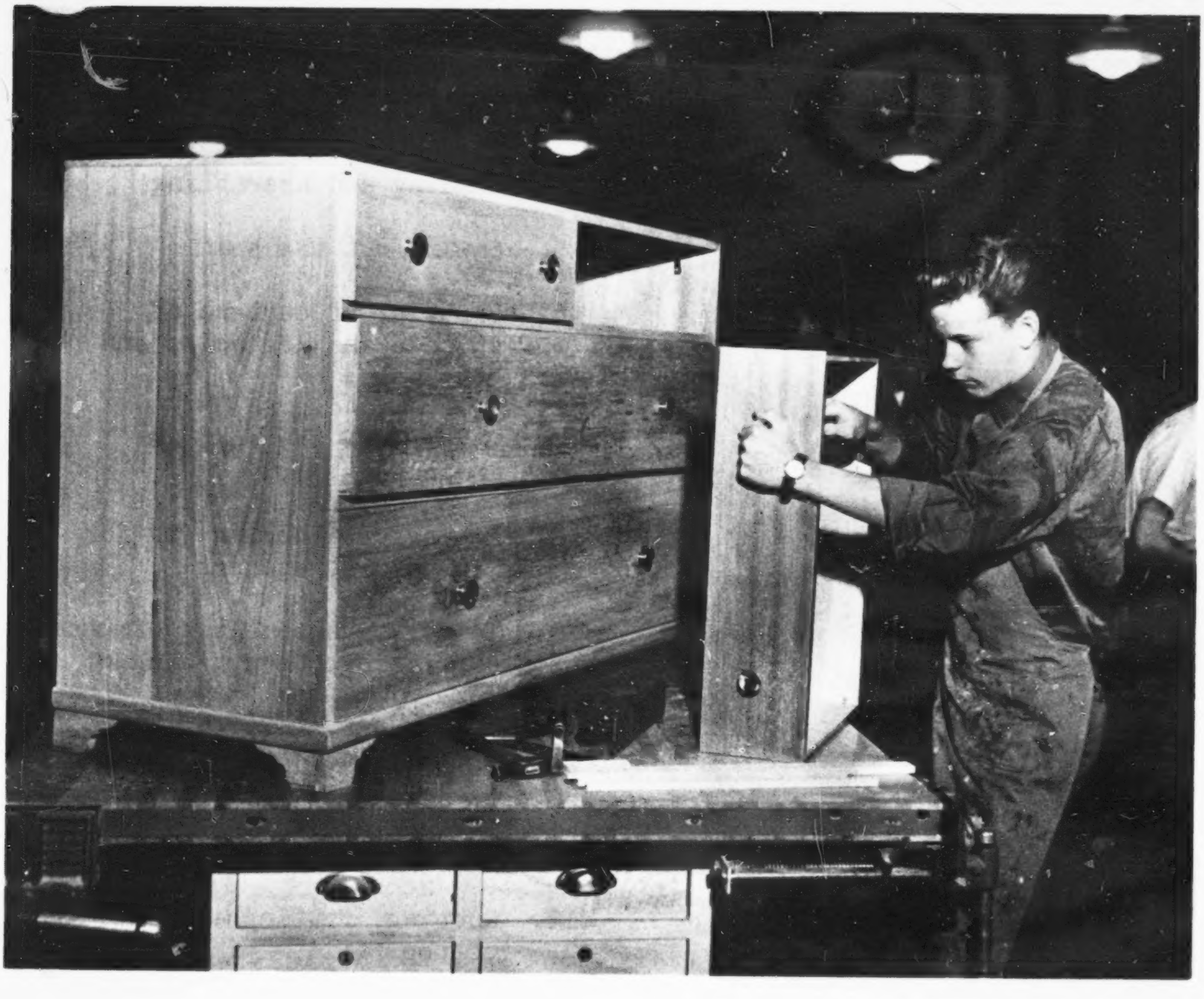
become adept in applying a shellac finish

C. Project #3 - a cabinet

1. Selecting of a design
2. Making cf bill of material
3. Lay out of top and cutting to size
4. Lay out and cutting of cabinet parts
5. Cutting of rabbets as needed
6. Cutting of shelf and legs
7. Sanding of all parts for assembling
8. Locating and drilling of holes for dowels, and for doweled joints
9. Assembling of cabinet
10. Attaching of door hinges and pulls
11. Sanding for finishing
12. Staining, use of filler and shellac

Project #3 - a cabinet

(References: 5, 8, 11, 14, 15, 32).



Applying Furniture Hardware

develop ability to turn legs and spindles on the lathe

learn to scoop out a chair seat using a wide shallow sweep gauge

gain experience in spotting and drilling holes for posts, legs, and spindles

D. Project #4 - a chair

1. Selection of the design and materials
2. Securing of materials
3. Shaping on the lathe of legs, stretchers, and spindles
4. Sanding and assembling
5. Sawing out the seat
6. Spotting of centers of spindle and leg holes and bore holes
7. Shaping of the seat as indicated
8. Making of a boring jig for legs and stretchers
9. Temporary assembling of base, of fitting, then gluing of legs by pairs
10. Scooping out of the seat
11. Assembling of back posts and spindles to seat
12. Cutting, fitting and sanding of top rail
13. Spotting of holes in top rail for posts and spindles
14. Assembling
15. Sanding
16. Applying of finish

Project #4 - a chair

(References: 5, 14, 23, 24, 28).

develop ability to construct chair frame for upholstering

learn to select upholstery materials suited for upholstering work

gain experience in the upholstering of a chair back and chair seat

develop experience in the use of upholstering tools

gain experience in selecting plastic or artifical leather covering material

develop ability to layout and cut plastic or artifical leather

become familiar with sewing on a welt

gain experience in joining border covers

become skillful in stuffing, and covering upholstery

E. Project #5 - chair - upholstering

1. Construction of frame of chair
2. Sanding and finishing before upholstering
3. Selection of upholstery fabric
4. Layout of the materials and cutting to correct sizes
5. Upholstering of chair back
6. Upholstering of chair seat

F. Project #6 - bench - upholstering

1. Construction of frame of bench
2. Selection of plastic or artificial leather
3. Layout and cutting of material to correct sizes for bench
4. Shaping of the top and sewing of welt around the top
5. Joining of border covers
6. Stuffing of top with moss
7. Covering with cotton
8. Stretching of joined covers
9. Tacking

PROJECTS

Project #5 - chair - upholstered

(References: 1).

Project #6 - bench - upholstered

(References: 1, 28).

learn to distinguish between good and poor design

know that it takes as much time and work to build a piece of furniture of poor design as one of good design

become skillful in cutting mortise and tenon joints

develop ability to apply a finish which is professional in its appearance

G. Project #7 - bed

1. Selection of a good design
2. Making of a bill of materials
3. Securing of lumber and other parts
4. Layout and cutting of each piece
5. Turning on lathe on turned pieces
6. Sanding of all parts
7. Cutting and fitting of joints
8. Temporary assembling
9. Making readjustment of fittings
10. Gluing and assembling
11. Sanding
12. Finishing
13. Attaching of hardware

PROJECTS

Project #7 - bed

(References: 1, 6, 8, 14, 23, 24, 28, 33).

develop ability to work with woods such as cherry, cedar, and pine

learn to make trays and tray supports

develop skill in fitting of lid to chest

become proficient in fitting hinges and locks to chests

develop some ability to do a hand rubbed finish

H. Project #8 - chest

1. Selection of design and drawings of the chest desired
2. Making a bill of materials
3. Securing of the lumber and hardware needed
4. Determination of kinds of joints to be used
5. Layout and cutting of materials including joints
6. Fitting of all joints
7. Making of necessary adjustments
8. Assembling of lid and body
9. Fitting of lid to body
10. Finishing
11. Attaching of hinge, lock, and ornaments

PROJECTS

Project #8 - chest

(References: 6, 14, 15, 16, 24, 28, 33).

learn to work with fine lumber such as walnut or mahogany

develop extremely good craftsmanship in making this project

become proficient in the finishing of wood bookcase

I. Project #9 - bookcase

1. Designing of the bookcase or selection of a good contemporary design
2. Making of materials list
3. Obtaining of lumber and hardware
4. Lay out and cutting of lumber to size
5. Fitting and sanding of parts
6. Gluing and assembling
7. Sanding
8. Finishing
9. Attaching hardware

Project #9 - bookcase

(References: 8, 11, 21, 28, 32, 33).

learn how to measure the job for building a cabinet to fit existing conditions	J. Project #10 - cupboards 1. Selection of style of corner cupboards
become proficient in adjusting sketches to fit on the job dimensions	2. Measuring of corner in which cupboard is to fit so that dimensions may be adjusted
develop some skill in making drawers and doors as well as fitting them	3. Adjustment of dimensions on drawings to correspond to those of the corner of the room
learn to glaze cabinet doors	4. Securing of materials and hardware after listing materials needed
become skillful in changing doors using butt hinges	5. Building of frame
	6. Fitting of doors and drawer
	7. Fitting of shelves and shelf supports
	8. Cutting and fitting of moldings
	9. Sanding
	10. Assembling
	11. Finishing
	12. Attaching hinges and drawer pulls
	13. Glazing of door

Project #10 - cupboards

(References: 14, 24, 28).

be able to make a dowelled butt joint

develop skill in gluing up a large top

develop ability to sand and finish a large surface

become proficient in securing the table top to the frame

K. Project #11 - dining table

1. Obtaining of a set of drawings for a contemporary style table
2. Making of a bill of materials
3. Securing of necessary items
4. Gluing up of lumber to get table top and table leaves
5. Layout and cutting of parts to size
6. Sanding of pieces and fitting of parts
7. Temporary assembling
8. Adjustments of parts
9. Permanent gluing and assembling
10. Finishing

Project #11 - dining table

(References: 14, 28).

develop ability to make glazed doors and fit them to the cabinet frame

become proficient in installing glass in doors and fitting it with moldings

become adept at fitting hinges and mortised locks to cabinet work.

L. Project #12 - secretary

1. Selection of a good design
2. Making of a bill of materials
3. Obtaining of materials and hardware
4. Lay out and cutting of materials to size
5. Sanding
6. Cutting and fitting of joints
7. Temporary assembling
8. Permanent gluing and assemble
9. Sanding
10. Finishing
11. Installation of glass in doors
12. Attaching of hardware

Project #12 - secretary

(References: 14).

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FIELD TRIPS

Not all experiences can be presented to pupils in a classroom situation. Sometimes audio-visual aids can be used to bring additional experiences into the classroom. Experiences which cannot be provided in the classroom frequently may be provided through a field trip. All field trips should be thoroughly planned. Contact authorized person in charge of the property or institution to be visited and make sure the things to be viewed will be of educational value to the pupils. Before leaving on the trip prepare the pupils for significant things to be noticed and observed. The tours suggested are samples; there may be others in your own locality which will be beneficial.

1. Museum of Science and Industry
East 57th Street and South Shore Drive
(See exhibits on woods.)

2. Local Lumber Yard
Try to arrange so that you can see the mill room in operation where such things as doors, windows, and fireplace mantels are being made.

3. New Houses - Under Construction
If possible, arrange to visit one about the time the interior trim and cabinets are being installed. Contact contractor for permission.

4. Industrial or Commercial Building
Visit when this is receiving its interior trim and millwork. The installation of cabinets, office partitions, etc. Contact contractor for permission.

5. The Art Institute of Chicago
Michigan Avenue at Adams Street
(See exhibit of Thorne Rooms - miniatures of period furniture.)